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AN EXPERIMENTAL STUDY OF THE PHYSIOLOGICAL ACCOMPANIMENTS OF FEELING.

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It had practically been taken for granted since the time of Kant that all feelings might be classified as pleasantness or unpleasantness until Wundt propounded his theory of the three directions of feeling. He names them pleasantness — unpleasantness, excitement — repose, and strain — relaxation. This psychologist believed that he had not only the evidence of his own introspection and that of others in favor of this view, but also the results of certain psycho-physiological experiments which showed that each of the six sorts of feeling had as its accompaniment certain changes in the vaso-motor system. These experiments were chiefly those of Mentz[1] and Lehman,[2] the former having made use of the sphygmograph and the latter the plethysmograph for recording the radial artery.

Not long since Dr. Max Brahn published an article[3] setting forth the conclusions reached from a long series of experiments made for the purpose of testing the tridimensional theory of feeling, and he finds six forms of pulse changes, each one of which is the persistent accompaniment of some one of the six kinds of feeling. It was also with the purpose of a test of this theory that the following experiments were undertaken and I find that in the main the results are a corroboration of those of Dr. Brahn.

[1] 'Die Wirkung akustischer Sinnesreize auf Puls u. Athmung,' *Phil. St.*, Vol. XI.

[2] *Hauptgesetze d. Gefühlsleben*, Leipzig, 1892.

[3] Brahn, 'Ex. Beiträge zur Gefühlslehre,' *Phil. St.*, Vol. XVIII.

It were perhaps useless to go into a lengthy account of the tridimensional theory. It is to be found in Wundt's[1] later psychological works and Brahn has given a short resume.[2] It is very probable that the differences in the one-dimensional and tridimensional theories arise from inaccurate introspection which does not clearly distinguish between sensation and feeling; from loose concepts as to the meaning of feeling; and from vague theories as to the origin of feelings and their physiological accompaniments. Wundt calls feeling the subjective element of psychical life and says that in seeking for the physiological accompaniments 'it follows from the subjective nature of the feelings, that we should not expect to find them among the processes produced in the organism directly by external agents, as the sensations are, but rather in *reactions* which arise indirectly from these first processes.'[3] Again Wundt does not allow that there is such a thing as a concrete state called pleasantness or excitement, but believes that these are only general names under which a multitude of feelings are brought which have a certain general resemblance. But putting theoretical questions aside we shall pass on to the account of the experiments.

Instruments and Methods of Procedure.

Preliminary experiments for this study were carried on at the University of Cornell during the fall of 1902 but nearly all of the results which are embodied in this report were obtained from experiments made at the University of Illinois in the spring semester and the summer of 1903. I used a Marey's sphygmograph for part of the experiments and for others a smaller and simpler one, which was very useful when the pulse lay very near the surface of the arm, as it did with some subjects. The record was always taken from the radial artery, usually the right one, with the arm in a supine position and resting comfortably on a high cushioned stool. For registering the pulse changes air transmission by means of a thick walled rubber tubing and Marey's tambours was used, the writing lever being laid lightly

[1] Especially *Outlines of Psych.*, 1897, p. 82, ff., *Phil. St.*, Vol. XV.

[2] *Op. cit.*, pp. 127–132. For a criticism see Titchener, *Zeit. f. Psy. und Phys.*, Vol. XIX.

[3] Wundt, *Outlines of Psych.*, p. 86.

on the smoked paper of a regularly revolving drum. The kymograph was rendered as noiseless as possible by placing a heavy felt mat under it. An electro-magnetic time marker connected with a second pendulum recorded the time while another electro-magnetic marker was used for recording the beginning and the close of the experiment, interruptions, or special signals by means of a double contact key which was inserted in the circuit and was sometimes in the hand of the operator or an assistant, and sometimes in that of the subject, as the circumstances of the experiment required. Later on I also used the pneumograph, but more by way of control for the pulse records. In nearly all cases the thoracial breathing was taken, and while the instrument was not very sensitive it seemed to be accurate within its limits. The breathing curve was registered in the same way as the pulse.

Much has been said for and against the sphygmograph as an instrument adapted to precise and accurate work. The criticism most often made is that it gives only the frequency of the heart pulsations since the plethysmographic effects are so great that the strength of the pulse cannot be accurately measured; that is to say, the volume of the arm changing, the pressure of the spring adjusted to the throbbing artery is changed, and therefore the excursion of the same is changed. In reply to this objection Brahn has spoken at some length,[1] citing von Frey as authority.[2] The conclusion is that such an error is present only where the change in volume is very great, for example, where the arm is tightly bound or in Valsalva's experiment, but that in ordinary experiments, especially of short duration, the error is neglible. Several curves were taken simultaneously with the plethysmograph on the left and the sphymograph on the right arm during the course of my experiments, and after careful scrutinizing of the two records I can find no traces of such an error. However, I do find the sphygmographic curve much plainer and more regular with more pronounced and uniform characteristics. Of course the sphymograph requires the most carefnl adjustment to begin with and I found several per-

[1] Brahn, *Phil. St.*, Vol. XVIII., pp. 143–144.
[2] Von Frey, *Die Untersuchung des Pulses*, Berlin, 1892.

sons who were unsuitable as subjects on account of the pulse lying too near the surface of the arm, or too deep, and each individual required a different amount of pressure to insure the most accurate results.

The experiments were conducted in a quiet room between nine and eleven o'clock in the morning and two and four in the afternoon, the subject sitting usually three quarters of an hour. My subjects were nearly always in a fresh condition but for the sake of observing the physiological effects and the variation in the results when one was tired or slightly indisposed, the subjects were occasionally taken in a slightly abnormal condition. One subject slept for twenty minutes during which time I took a number of records. Another subject who had just been smoking before he came in showed such a weak and irregular pulse that nothing much was to be gotten out of it for psychological purposes.

The introspections were given conscientiously and carefully and whenever there was reason to suspect anything wrong the whole experiment was thrown out. I did not especially train my subjects in introspection as Brahn did, but occasionally asked them to compare or contrast certain feelings. I sometimes cautioned them about distinguishing clearly between feelings and sensations. Occasionally an assistant was present and usually two persons were required to conduct the experiment if I was the subject. For this service so kindly performed I wish to thank Mrs. Alice Parks and Professor Colvin, as well as for their participation as subjects. My other subjects were unpracticed observers, or comparatively so, and were kept totally ignorant of the real purpose of the experiment in order that their introspection should not be influenced by any desire to make the proper introspection.

Measurement.

The measuring of the curves is a matter of great importance. It did not seem to me that the highest accuracy was to be obtained by measuring each pulse length as Brahn does. In the first place the variations are so small that the mechanical error in measuring may be considerable; and secondly, the

variations of single pulse curves within a respiratory oscillation are so great that errors are likely to arise if due notice is not taken of this fact. Mentz adopted the plan of taking the mean averages of the shortest and longest curves of each oscillation. I modified this plan, simply measuring each oscillation and taking the mean average of the whole number of pulses, beginning with whichever pulse occurred first in the reaction as the starting point for all measurements for that particular instance. Lehman's method of following the natural groupings according to pulse lengths seems most unscientific, while some one has hit upon the ingenious plan of measuring the first half of the reaction and the second half separately and comparing the mean averages of the curves. The instrument used in measuring was a vernier recording tenths of millimeters.

Different rates of rapidity were used for the revolving drum but for paper 480 mm. long 93 and 80 seconds time was most frequently used. The measurement of the breathing I shall only give in words as also that of the height of the pulse.

No attempt will be made to reproduce the curves since it is impracticable to reproduce all and a few isolated curves would have little value since each curve should be read in comparison with the normal curves and other curves of the subject.

A Brief Account of the Results of Other Investigators.

As to the results of the experimental work previously carried on in this field a few words should be said, and first in regard to the parallel physical processes of attention.

Involuntary attention: Mentz[1] finds that acoustical stimuli received with involuntary attention caused a slowing of the pulse and usually of breathing. Lehman[2] says that an intense and sudden sensation causing attention usually does not affect the breathing; the first pulses are usually short but afterwards become longer and so the general characteristic of the curve is a lengthened pulse. Mosso's[3] statement that the sensations from

[1] *Op. cit.*

[2] *Körperliche Äusserungen psychischer Zustände*, Leipzig, 1899.

[3] *Diagnostik des Pulses*, Leipzig, 1879. *Die Temperatur des Gehirns*, Leipzig, 1893.

the various sense organs cause a slowing of the pulse while the breathing changes show no satisfactorily uniform result finds support in the two later experiments.

Zoneff and Meuman[1] find that there is no difference between involuntary and voluntary attention but say that a concentration of the attention causes a slowing of the pulse and an obstruction in the breathing. In respect to sense and intellectual attention the breathing is more obstructed in the former.

Voluntary attention, according to Mentz, is accompanied by a quickened pulse and usually more rapid breathing. Lehman's results shows a quickened pulse. If it is a case of long-continued intellectual work the breathing is usually more rapid and shallow.

Brahn discusses strain as the feeling side of attention, and prefers the expressions prepared and unprepared attention to that of voluntary and involuntary. Prepared attention gives the best form of strain while unprepared attention is likely to be ushered in by a feeling of excitement, which may be changed to that of strain only to be replaced again by excitement. Naturally some stimuli to which we attend do not cause a strain but pleasantness, unpleasantness or quietness according to their nature. This state of strain is accompanied by a quickened pulse and pronounced or low dicrotic while the opposite feeling of relaxation is accompanied by a slowed pulse and high dicrotic. In regard to the fluctuations of attention Neuman and Zoneff say that according to the degree of concentration of attention the breathing and pulse is obstructed, whereas so soon as the concentration is diminished it becomes faster. This statement is to be criticised later on.

As regards pleasantness and unpleasantness there is practically universal agreement. Mentz finds in the case of the former a slowing of both pulse and breathing and for the latter the reverse. While agreeing with this, Lehman says in addition that pleasantness is accompanied by a heightened pulse curve and unpleasantness by a lower.

Zoneff and Meuman find pleasantness accompanied by a less rapid pulse, but with more rapid and shallow breathing, while the reverse is true for unpleasantness.

[1] *Phil. St.*, Vol. XVIII.

Brahn agrees with Lehman is regard to pleasantness and unpleasantness. Excitement is accompanied by a heightening of the pulse without the lengthening, while repose is accompanied by a decrease in the height without change in length. Brahn follows Wundt's suggestions about the choice of stimuli, those for the different sense organs being accompanied by different feelings, such as taste stimuli by pleasantness and unpleasantness, color by excitement or repose. Also high and low tones were likely to produce one of the last named pair. This author believes that in the light of his knowledge of the feelings which certain stimuli arouse and their physiological accompaniment he is able to find many traces of feeling in the works of other investigators.

He finds that Féré[1] asserts that all feelings of depression show a diminution in the volume of the extremities while all feelings of excitement and pleasure show a volume increase. Strain and relaxation are also mentioned. In regard to Mentz,[2] he says: 'We need only to follow the meaning of sthenic and asthenic and of voluntary and involuntary attention without prejudice and take the matter in an elementary way in order to find the three directions of feeling.' Also in Dumas',[3] Binet-Courtier's,[4] and Binet-Vaschide's[5] works he finds hints of the tridimensional theory, and in Lehman's[6] latest work he believes that if the author had analyzed more thoroughly and adopted the tri-dimensional theory many of the results would coincide with his own. I shall speak of these works later in comparison with my own results.

[1] Féré, *Sensation et mouvement*, Paris, 1887.

[2] Mentz, *op. cit.*

[3] 'Recherches experimentales sur la joie et la tristesse,' *Revue philos.*, 1896.

[4] 'La circulation capillaire dans ses rapports avec respiration et les phenomenes psychiques,' *L'Année psychol.*, II.

'Influence de la vie emotionelle sur le coeur, la respiration et la circulation capillaire,' *L'Année psychol.*, III.

[5] 'Influence du travail intellectuel, des emotions, du travail physique sur la pression du sang,' *L'Année psychol.*, III.

[6] *Op. cit.*

Strain and Relaxation.

Strain and relaxation are the feeling side of attention. The feeling seems to be strongest when the subject is attending to stimuli about 8 seconds apart, the intervening time between the signals being free from any sensations or ideas, and all consciousness being intent on the recurring signal. However attention is sometimes accompanied by what the subject frequently designates as concentration. Here the feelings of strain and relaxation are not so pronounced, although my own introspection and that of others find them present. This is the case where one attends to a continuous succession of stimuli or ideas without an appreciable interval between. It is interesting to note that the physiological accompaniment of the two are somewhat similar. We find voluntary attention is accompanied by the purest forms of strain and relaxation, involuntary attention being often accompanied by excitement. In the following experiments we are to think of attention as being the former.

Experiment I. — P. P. 7/16/'03. This subject has on this occasion a marked respiratory rythm in the sphygmographic curve of about 11 pulses and his breathing was unusually slow and deep during a state of rest. The stimulus was the clicks of a double contact key which by means of the magnetic time marker were recorded on the smoked paper. The breathing at once became more shallow and about twice as rapid while the respiratory rhythm is much less pronounced, occurring every four or five pulses. The pulse is somewhat lower with a lower dicrotic during the period of strain while the pulse is higher with a higher dicrotic during the period of relaxation. The pulse rate is more rapid during strain than relaxation.

	Normal.	Strain.	Relaxation.	Strain.	Relaxation.	Strain.
No. of pulses,	4–5	4–4	4–4	4–4	4–5	5–5
Av. length,	5.2 5.1	5.1 4.8	5.1 5.1	4.8 4.8	5.5 5.1	4.8 4.9

At this point there seems to be a change. We have at relaxation 4.9 and 4.6 followed by 5.3, 5.1, 5.

Experiment 2. — P. B. 8/5/'03. Stimulus was clicks as before 5 seconds apart. The breathing was shallow and rapid while the respiratory oscillation almost entirely disappeared. Dicrotic changes as before.

	Strain.	Relaxation.	Strain.	Relaxation.	Strain.
No. of Pulses,	3–4	5	6	5	6
Av. length,	5.5 5.1	5.3	4.9	5.3	5

Here as in the former experiment a change is apparent. We find next 4.9 4.9 4.6 4.9, which according to the subjects' introspection is a sort of shifting or adjusting of the attention.

Experiment 3. — P. P. 7/14. The stimulus was again clicks about five seconds apart and the subject felt strain and relaxation.

	Strain.	Relaxation.	Strain.	Relaxation.
No. of pulses,	6	6–2	4–4	4–4
Av. length,	4.9	5.3 5.5	5.1 4.9	5 5.1

The dicrotic changes are as before.

Experiment 4. — A. P. 7/20. Stimulus is clicks eight seconds apart. The dicrotic changes are the same, low in strain, high in relaxation.

	Normal.	Strain.	Relaxation.	Strain.	Relax.	Strain.	Relax.
No. of pulses,	5–5	5–5	5–5	5–5	5–5	5–5	5–5
Av. length,	4.7 4.7	4.7 4.7	4.9 4.8	4.8 4.9	4.8 4.8	4.7 4.7	4.8 4.9

This subject shows very little change in pulse length in any reaction.

Experiment 5. — A. P. 7/16. Stimulus was clicks five seconds apart, which came too quickly for this subject, so that she was somewhat excited all the time.

Experiment 6, following a few minutes after with clicks ten seconds apart caused a feeling of depression although the strain and relaxation were also felt.

Experiment 7. — A few minutes after this clicks eight seconds apart seemed to give pure feeling of strain and relaxation, that is, the taps came just when expected, neither too soon nor too late.

Experiment 5.

	Normal.	Strain.	Relaxation.	Strain.	Relax.	Strain.	Relax.
No. of pulses,	5–5	7	6	7	6	7	6
Av. length,	4.5 4.5	4.5	4.3	4.5	4.5	4.5	4.5

Experiment 6.

No. of pulses,	5–5	6–6	6–7	6–7	6–7	6–7	6–7
Av. length,	4.5 4.5	4.5 4.5	4.5 4.4	4.4 4.4	4.4 4.4	4.3 4.3	4.3 4.3

Experiment 7.

No. of pulses,	5–5	5–5	5–5	5–5	5–5	5–5
Av. length,	4.3 4.3	4.4 4.6	4.4 4.4	4.4 4.6	4.4 4.4	4.4 4.3

In all three of these the curve shows the dicrotic changes, the lack of variation in length is no doubt due to excitement in the first curve and depression in the second. The shortened pulse during the first period of relaxation of first curve is due to unpleasantness according to the subject's introspection. In the second curve we find the greater frequency of the pulse which so often accompanies prolonged attention.

In the third curve there is already present a low dicrotic and during the first period there is a stronger pulse with now a high, now a low dicrotic. The next shows a uniformly high dicrotic, while the last shows a lower dicrotic. The whole curve is very low and becomes almost threadlike, showing, I believe, the effects of fatigue.

Experiment 8. — P. B. 7/5/'03. Stimulus: clicks eight seconds apart.

	Normal.	Strain.	Relaxation.	Strain.	Relaxation.	Strain.
No. of pulses,	5	5-5	4-5	5-5	5-5	5-5
Av. length,	5	4.4 4.8	5 4.8	5 4.9	5 5.1	5 4.9

The breathing is rapid and shallow and the dicrotic during the first period of strain is low, increasing gradually in height until the middle of the next period, but for the remainder the dicrotic changes are not so marked. My introspection here was that the taps were too weak and far apart and so I became confused without any feeling of strain and relaxation.

In a word, we find in agreement with Brahn that strain is a feeling whose physiological accompaniment is a quickened pulse with a lower dicrotic while its opposite feeling, relaxation, is accompanied by a slower pulse with higher dicrotic. In regard to the breathing, of which Brahn does not take account, it is more rapid, regular, and shallow than in a state of rest. The respiratory rhythm disappears to a very large extent. This feeling, like every other feeling cannot exist in strength for any great length of time but gives way to a sort of confused state caused by the shifting of attention (Ex. 1, 2, 8). The physiological processes also lose their pronounced characteristics during this period. I find a difference in subjects in regard to the time of the appearance of strain and relaxation as it depends on the quickness of the subject in responding to stimuli.

There are a number of experiments which were undertaken in order to ascertain what effect the state of attention during psychical activity had upon the vaso-motor system. My own introspection and that of my subjects give a feeling of concentration as the accompaniment of attentive, psychic action, which is largely the feeling of strain, flash-like period of relaxation preventing its becoming too strong. Between the curves of attention with the feeling of concentration and strain and relaxation there is a great resemblance.

Experiments 9. — S. C. 5/12/'03. The subject looked at a figure of tumbling blocks. Each time the figure took a different form the subject pressed the electric contact key and recorded the fluctuation on the drum. The breathing was shallow, rapid and regular; the apex of the breathing curve usually coincided with the time of fluctuation. Sometimes the fluctuation did not occur at every breath but at the second breath. Normal average length of pulse is 5 mm.

Fluctuations,	1	2	3	4–5	6	7	8–9	10	11
No. of pulses,	5	5	5	5	6	6	6	4	7
Av. length,	4.3	4.4	4.1	4.5	4.2	4.3	4.6	4.6	4.5

Fluctuations,	12	13	14–15	16	17–18	19	20–21	22
No. of pulses,	7	5	5	5	5	5	5	5
Av. length,	4.5	4.1	4.2	4.3	4.3	4.4	4	4.7

The dicrotic changes correspond roughly to changes in length which occur with the fluctuations. It is lower on the whole than in the normal.

Experiment 10. — S. C. The subject looked at a very simple figure this time and the fluctuations were more regular, corresponding as before to the breathing apex. The concentration was not so great and the breathing is correspondingly slower, especially at first. The dicrotic is high during the first twenty pulses, after which it becomes lower and fluctuates with variations in length of the pulse curves.

Fluctuations,	1–2	3–4	5–6	7–8	9–10	11–12
No. of pulses,	4	4	4	4	4	4
Av. length,	4.8	5	4.8	4.7	4.7	4.6

Fluctuations,	13–14	15–16	17–18	19–20	21–22
No. of pulses,	4	6	8	7	7
Av. length,	4.6	4.8	4.6	4.8	4.6

Fluctuations,	23–24	25–26	27–28	29–30	31–32
No. of pulses,	8	8	6	7	8
Av. length,	4.5	4.4	4.4	4.3	4.4

The average length of these pulses is greater than in the preceding.

Experiment 11. — E. C. 5/22. The subject attended this time to the counting of a clock's ticking. He said he was obliged to concentrate his mind on it. The breathing is shallow and rapid. The respiratory rhythm tends to disappear although it is usually quite pronounced and is moreover a three pulse rythm. His normal pulse is regular as to height but irregular as to length, its average perhaps being 6.6.

No. of pulses, 3 throughout.
Av. length, 6.5 6.3 6.3 6.5 6.1 6 5.9 6.3 6 6.3

The dicrotic is lower excepting at 6.5, 6.1, with a slight rise at the last 6.3.

Experiment 12. — E. C. 5/22. After a short pause the subject listens to a music-box medley to which he attends without much effort and some pleasure. The breathing is deeper and slower and the rhythm in pulse more pronounced.

No. of pulses, 3 throughout
Av. length, 5 5 5 6.3 (Before.) 6 6.8 6.8 6.4 6 6.6 6, (Stimulus.)

During the four periods before the stimulus and the first after, the dicrotic is low. After that it is higher but fluctuates somewhat. The average length of pulse is greater than during the preceding experiment. The subject appeared to be on a strain before the stimulus began.

Experiment 13. — A. P. 5/21/'03. The subject is reading an interesting essay. Breathing characterized by long pause after expiration, fairly regular, and of medium depth.

No. of pulses, 5 throughout.
Av. length, 4.5 4.3 4.3 4.2 (Before.) 4.2 4.1 4.2 4.3 4.3 4.2 (Reading.)
4.4 4.1 4.4 4.3 4.1 4.1 (Reading continued.)

The dicrotic is lower generally but shows variations corresponding to the length of the pulses.

Experiment 14. — A few minutes afterwards another tracing is taken, the subject having read on without interruption. The breathing is more rapid and shallow. In both the respiratory rhythm almost disappears. The dicrotic changes are as before.

No. of pulses, 5 throughout.

Av. length,	4.3	4.3	4.2	4.2	4.4	4.3	4.4	4.2	4.3	4.2
Av. length,	4.5	4.4	4.8	4.6	4.6					

At this point a violet odor was given to the subject. It was pleasant but subject could not concentrate her mind on her reading again. The pulse shows a lengthening.

Experiment 15. — S. C. 5/12. Subject is reading an interesting selection.

No. of pulses, 5 throughout.

Av. length,	5	4.8	4.8	5.2	5

The dicrotic is rather high throughout, a little higher at 5.2 than elsewhere.

A little later another tracing is taken while the reading is still going on. The pulse is more rapid as is also the breathing while the dicrotic is lower.

No. of pulses, 5 throughout.

Av. length,	4.3	4.4	5	5	4.8	5	4.7	4.7	5

Several times I have mentioned the disappearance of the respiratory rhythm in the pulse during attention. This was very marked with two subjects whose respiratory rhythm was usually so pronounced that the tracings were once discarded so far as the question of emotional accompaniment was concerned. However with these subjects any sort of rhythmic action, bodily or psychical, tended to destroy the respiratory rhythm in a remarkable degree.

Experiment 16. — C. W. 4/24. The subject was a very athletic young woman, generally not responding emotionally to stimuli. A slow in and out movement of the free arm caused a greater rapidity of pulse with a little increase in height, the rhythm almost disappears, while the dicrotic is high in the outward and low in the inward movement curve.

	Normal.	Out.	In.	Out.	In.	Out.	In.
No. of pulses,	11	12	11	13	14	10	18
Av. length,	4.3	3.6	3.5	3.1	3.5	3.3	3.5

Another experiment with the same subject in which she opened and closed the hand resulted in practically the same tracing.

Experiment 17.—E. H. Another subject showed still greater variation of pulse within an oscillation, sometimes the highest and longest pulse being almost twice the dimensions of the smallest. The arm movement caused the rhythm to disappear to a great extent as did a ticking metronome which 'bothered' the subject. During a Beethoven selection on an organ which the subject pronounced 'sleepy,' 'monotonous,' the breathing is rapid and shallow with great regularity of the pulse.

	Before.			Music.			After.
No. of pulses,	10–10	10	10	10	10	10	10
Av. length,	4 3.8	3.6	3.5	3.6	3.5	3.5	4.4

The dicrotic was somewhat lower during reaction.

The most marked and regular respiratory rhythm was observed in the tracing of a subject who peacefully slept for twenty minutes while records were being taken. It was impossible to arouse the subject sufficiently to take part in the experiment with attention and in the tracings taken during a waking condition the rhythm persists strongly.

The results show a striking resemblance to the results of the previous series of experiments. Rapid, regular, shallow breathing, a more rapid pulse on the whole and dicrotic changes in the pulse corresponding to variations in length. Also the rhythm parallel with respiratory movements tends to disappear.

The results agree with those of most other experimenters as regards the greater frequency during attention, Binet and Courtier[1] having also called attention to the fact that the dicrotic is later and lower during psychical activity.

Meuman and Zoneff, however, find a slowing of the pulse during both sense and intellectual attention. I should be inclined to attribute this result to the choice of stimuli used. Nearly all require precise muscular accommodation of the sense organ. For example, a card containing five points was brought near until the subject was able to count them; another time a ticking watch is brought within hearing; again it is to determine the threshold for the sense of touch according to Weber. All

[1] 'Circulation Capillaire,' *L'Année psychol.*, Vol. III.

of these require or at least call forth an involuntary holding of the breath in order to further the sense accommodation.

The same is true in the case of the fluctuations of attention. I found myself 'holding my breath' when I tried to keep a wire moving along a certain line. A criticism might also be made upon the choice of stimuli in intellectual attention. Problems in mental arithmetic are likely to arouse excitement, confusion, pleasantness, or unpleasantness, according to the ease and success with which they are solved. Then again their conclusions do not seem to be justified by the results. In three out of ten experiments the pulse is more rapid. In five the pulse is more rapid during the first ten seconds and in another equal. In one experiment the rate is only given for the whole reaction so that there are only three cases where the pulse is first slower and in one of these the second ten minutes show a greater frequency. On the whole their results are not so much at variance with those of others as it seemed at first glance that they might be.

Pleasantness and Unpleasantness.

In regard to pleasantness and unpleasantness, little new has been found regarding their physiological changes in the vasomotor system. Pleasure is almost always accompanied by a slower pulse and unpleasantness by a quicker pulse, the height usually increasing in the former and decreasing in the latter. The following are a few examples:

Experiment 18. — A. P. 4/9/'03. Subject was amused at a high organ note.

No. of pulses,	5	5	5	curve slightly.
Av. length,	3.8	4.4	4	higher at 4.4.

Experiment 19. — S. C. 5/4/'03. White rose odor was pleasant.

No. of pulses,	5	5	5
Av. length,	4.5	5	4.8

Experiment 20. — L. B. 5/12. Clove oil was pleasant.

No. of pulses,	5	5	5	5	5
Av. length,	4.2	4.2	4.4	4.4	4.2.

Experiment 21. — S. C. 5/12/'03. A purple red colored glass held before the subject in front of a non-transparent window was pleasing.

No. of pulses,	5	5	5
Av. length,	4.8	5.3	5

Higher.

Experiment 22. — A. P. 5/7/'03. Turpentine odor called up a number of pleasant associations.

No. of pulses,	5	5	5	5	5
Av. length,	3.5	3.8	3.8	3.6	5.5

A very interesting fact about this subject is, that out of a large number of tracings taken when the subject gave the introspection of pleasant after an odor the pulse was seldom slower. By chance I discovered that the subject had a habitual dislike of all kinds of odors, which was stronger than the momentary pleasantness. This may account for the regular pulse variation being absent during these reactions. The feeling of unpleasantness is one which is comparatively easy to bring about but I shall give only a few of the reactions.

Experiment 23. — S. C. 4/20/'03. The stimulus was a disagreeable odor.

			Reaction.				
No. of pulses,	6	6	6	6	6	6	6
Av. length,	3.5	3.5	3.2	3.1	3.1	3.2	3.6

Lower.

Experiment 24. — S. C. 5/4/'03. The stimulus was a blue glass plate twice exposed but the subject was unable to focus it and hence had an unpleasant feeling.

				Reaction.				
No. of pulses,	6	6	6	6	6	6	6	6
Av. length,	4.6	4.7	4.5	4.2	4.2	4.5	4.2	4.2.

Occasionally a very disagreeable feeling caused a slowing of the pulse.

Experiment 25. — S. C. 4/13/'03. The stimulus was a painful pressure.

		Reaction.			
No. of pulses,	6	4	6	6	6
Av. length,	4.8	5.2	5.4	4	4.3

Higher.

Experiment 26. — A. P. 5/28/'03. The stimulus wa as few drops of lemon juice which was very disagreeable — 'terrible.'

No. of pulses,	5	5	5		
Av. length,	4.9	4.4	4		
		Lower.			

Experiment 27. — On another occasion the stimulus being again lemon juice the reaction was much the same.

No. of pulses,	5	5	5	5	5	5	5
Av. length,	4.5	4.5	3.9	3.6	3.8	4.2	3.7
			Lower.		Higher.		

In cases where the feeling of pleasantness or unpleasantness is mingled with other feelings the pulse changes show variations from the above as we shall see later.

Excitement and Repose.

Whether one is to consider excitement and repose as feeling is a matter of most accurate definition and careful introspection. But taking feeling in the sense of a reaction to sensations and ideas, we can perhaps call that consciousness of increased muscular or psychical power with a tendency to action a feeling to be designated by the terms excitement, or liveliness. The consciousness of weakened or inhibited psychical or physical force we may designate as a feeling of repose or depression. Either of these is less often found alone than other feelings and it is especially difficult to bring them about in the laboratory, Brahn having succeeded in finding five cases of pure excitement in two hundred curves. The stimuli best adapted for causing the feelings are bright-colored transparent plates, high or low tones, and the ticking of a metronome. Also certain odors bring about this feeling but it is more likely to be mixed with some other feeling. As I have said before, I measured the height of the curves only in terms of higher and lower. The following are examples of excitement.

Experiment 28. — L. B. 5/5. High chord of organ. Excitement.

No. of pulses,	5	5	5	5	5
Av. length,	4.6	4.6	4.6	4.4	4.6

Experiment 29. — L. B. 5/12. The stimulus was rasping files which first excited and then amused me.

No. of pulses,	5	5	5	5	5
Av. length,	4.4	4.4	4.4	4.5	4.2

Experiment 30. — L. B. 5/12. A shrill Galton whistle set my nerves on edge but I was obliged to smile to relieve the tension. I was on a strain in anticipation of what I suspected was coming.

No. of pulses,	5	5	5	5	5	5
Av. length,	3.7	3.8	4.2	4.3	4.2	4.2
			Higher.			

Experiment 31. — L. B. 5/18. Another day a high whistle excited, 'keyed me up.' I afterwards felt a thrill of pain behind the ear.

No. of pulses,	5	5	5	5	5
Av. length,	4.7	4.7	4.7	4.5	4.8
		Higher.			

Experiment 32. — L. B. 5/18. Ammonia caused a strong state of excitement.

No. of pulses,	5	5	5	5	5
Av. length,	4.7	4.8	4.7	4.7	4.7

Experiment 33. — L. B. 5/26. A bright yellow glass plate held between my eyes and the window caused a slight feeling of cheerfulness.

No. of pulses,	5	5	5	5	5
Av. length,	4.8	4.9	4.9	4.8	4.9

Experiment 34. — A. P. 4/16. A discord on the organ proved exciting.

No. of pulses,	5	5	5	5
Av. length,	3.9	3.9	3.9	3.9

Experiment 35. — A. P. 4/16. A red plate of glass caused a strong excitement; subject felt she must jump up from the chair; cold chills run up and down her spine. There was no doubt some unpleasantness present at the close of the experiment.

No. of pulses,	5	5	5	5	5
Av. length,	4.4	4.2	4.2	4	4.4
		Higher.			

Experiment 36. — A. P. 5/28. The same color proved 'something fierce' and subject felt cold chills after it was taken away.

No. of pulses,	5	5	5	5	5	5	5	5
Av. length,	4.4	4.6	4.4	4.7	4.7	4.4	4.6	4.8

Experiment 37. — A. P. 5/14. Red and yellow glass placed side by side was said to be 'awful, distracting.'

No. of pulses,	5	5	5	5	5
Av. length,	4	3.9	3.9	3.8	3.8
			Higher.		

Our conclusion then is that excitement is accompanied by a normal rate of the pulse but that the pulse is often stronger. In the cases where higher is not written there was no appreciable change in height. A number of curves were also recorded during a state of unpleasant excitement and pleasant excitement, while there are also cases of strain where excitement is present. The most striking examples of the last named combination are the reactions which took place during the ticking of a metronome which varied in rapidity from 48 to 90 strokes per minute. The following are a few examples:

Experiment 38. — L. B. 4/28/'03. The stimulus was a quick metronome and the reaction was a feeling of strained excitement. My usual expression was that it 'keyed me up.'

No. of pulses, 5 throughout.										
Av. length,	4.6	4.4	4.8	4.5	4.5	4.5	4.7	4.7	4.7	4.6

The dicrotic was lower during the first three periods and almost disappeared they were so high during the last two.

Experiment 39. — L. B. 5/26/'03. The stimulus was a very quick metronome while the reaction was a 'keyed up feeling.' I seemed to stop breathing and my heart seemed to beat faster.

No. of pulses, 5 throughout.										
Av. length,	4.8	4.8	5	5.3	5.3	4.8	4.8	4.8	4.9	

The height of the pulse and the dicrotic were both greater during the first two periods.

Experiment 40. — A. P. 4/9/'03. The stimulus was a slow metronome and the subject felt very excited, 'it was a torture to sit still.' The subject was expecting a stimulus of this sort.

				Reaction.						
No. of pulses, 5 throughout.										
Av. length,	4.1	4	4	4.1	4	3.9	3.9	3.9	3.9	4

The curve was higher with a higher dicrotic during the third period before the stimulus, then both apex and dicrotic become lower during the next two periods but become higher very gradually after the stimulus until the fourth period when they become lower and vary slightly till the end when the dicrotic becomes higher.

Experiment 41. — A. P. 4/16. The same stimulus as the above caused practically the same reaction and same physiological accompaniment.

				Reaction.					
No. of pulses, 5 throughout.									
Av. length,	4.1	4.1	4.1	3.9	4	3.8	3.7	3.7	3.7	3.8

Experiment 42. — S. C. 4/20. The stimulus was a metronome at the rate of 48 strokes per minute. The subject declared it to be exasperating and unpleasant.

No. of pulses, 6 throughout.									
Av. length,	4.4	4.3	4.4	3.9	3.7	4	3.8	3.8	3.9

The pulse curve is at first high with high dicrotic. During the next two periods both become lower while at the fourth period the curve is very irregular, showing on the whole a higher dicrotic. It gradually becomes lower until the end of the stimulus when it tends to return to the normal height.

Other examples might be given but as we are concerned more with simple than complex phenomena these must suffice to show that a mixed feeling of strain and excitement has physiological accompaniments differing from those of either of the pure states. A few examples will also suffice for the other mixed states.

Experiment 43. — A. P. 5/21/'03. A crash on the organ was surprising and unpleasant, distracting.

No. of pulses,	5 throughout.				
Av. length,	4.5	4.3	4.6	4.8	No variation in height.

Experiment 44. — A. P. 5/28/'03. A strange odor caused a strong feeling of surprise and unpleasantness.

No. of pulses,	5 throughout.				
Av. length,	4.8	4.8	4.6	4.4	4.5
			Shallower.		

Experiment 45. — S. C. 5/12/'03. A high whistle was irritating.

No. of pulses,	6	6	
Av. length,	4.8	4.8	No change in height.

Thus there seems to be no consistency in these results, certain physiological effects predominating at one time, at another time others, probably according to the difference in the composition of the feeling.

Experiment 46. — L. B. 4/28/'03. A high tone caused a feeling of excitement but was at the same time amusing.

No. of pulses,	5	5	5	5
Av. length,	5	5.2	5.3	5.3

Experiment 47. — S. C. 4/20/'03. Anise oil odor was pleasant and exciting.

No. of pulses,	6	6	6	6	6	6	6	
Av. length,	3.7	3.6	3.8	3.9	3.7	4	3.8	
			A trifle higher.					

Experiment 48 — S. C. 5/18/'03. Menthol proved a pleasant and stimulating odor.

No. of pulses,	6	6	6	6	6
Av. length,	4.5	4.5	4.6	4.4	4.4

Experiment 49. — A. P. 5/14/'03. A rich red plate of glass gave the subject a pleasant exhilarated feeling, 'toned her up.'

No. of pulses,	5	5	5	
Av. length,	4.2	4.2	4	
			Higher.	

The results here are more consistent because excitement and pleasantness have the heightened curve in common as a physiological accompaniment.

Repose or depression as a pure feeling occurred a few times and was usually not accompanied by any marked changes in the pulse either in the height or frequency. The following are examples.

Experiment 50. — L. B. 5/12/'03. A glass plate sage green in color was quieting.

No. of pulses,	5	5	5	5
Av. length,	5	4.9	4.9	4.8

Experiment 51. — L. B. 5/26/'03. Bergamot odor was heavy and depressing.

No. of pulses,	5	5	5	5	5	5
Av. length,	4.8	4.8	4.9	4.6	4.6	4.8

The after effect of this odor was unpleasant.

Experiment 52. — A. P. 5/14/'03. Sage green was depressing.

No. of pulses,	5	5	5	5
Av. length,	4.1	4.1	4.2	4.2

Experiments 53, 54, 55. — A. P. 5/7/'03. Low organ tones produced in these three cases a solemn quiet feeling.

No. of pulses,	5 throughout Reaction.						Reaction.				Reaction.		
Av. length,	3.6	3.5	3.7	3.7	3.7	3.6	3.6	3.8	37	3.7	3.6	3.5	3.7	3.6

Experiment 56. — 4/30. A light blue glass plate caused a feeling of depression.

No. of pulses,	5	5	5	5	5
Av. length,	3.9	3.8	4.3	3.9	3.9

Experiment 57. — L. B. 5/5'03. A low organ tone was felt as earnest, rich, a somewhat peculiar feeling but fitting in here because it seemed to induce repose.

No. of pulses,	5	5	5	5
Av. length,	5	4.6	4.8	4.7

Experiment 58. — This was followed by the odor of castor oil which was depressing.

No. of pulses,	5	5	5	5
Av. length,	4.7	4.6	5	4.4

In all of the above cases there is very little variation in the length of the pulse curves and little or none in the height. There is not so far as I can see the uniformly lowered pulse which Brahn finds, however there is certainly not an increase in height in any of them. The failure to find the lowered pulse may be due to the fact that the cases are not those of pure repose, though this seems very unlikely. I am much more inclined to think that the feeling of excitement and repose is far more often accompanied by muscular than circulatory changes. A number of experiments with the automatograph and ergograph which I shall not describe here, as well as the introspection of my subjects led me to this supposition. In nearly all cases of pronounced excitement the subject speaks of a desire to move, while in the repose the quiet, restful effect is spoken of. Everyday observation teaches us that certain music has the effect of stimulating to action while other melodies have a soothing, sleepy effect, etc. and one is very averse to movement.

Just as in the case of excitement so here in repose we find mixed feelings; repose and pleasantness and repose and unpleasantness. The following are examples:

Experiment 59. — A. P. 4/16/'03. A low tone produced a feeling of unpleasant sadness.

No. of pulses,	5	5	5	5	5	5
Av. length,	3.8	4	3.8	4	3.8	4

Experiment 60. — L. B. 4/28/'03. A low organ tone was pleasant and quieting.

No. of pulses,	5	5	5
Av. length,	4.8	4.8	4.8

Experiment 61. — A. P. 5/21/'03. A low organ tone was pleasant and rich.

No. of pulses,	5	5	5
Av. length,	4.4	4.4	4.4

Experiment 62. — S. C. 4/5/'03. Light blue glass was quiet and pleasant.

No of pulses,	5	5	5	5	5
Av. length,	3.5	3.4	3.7	3.6	3.6

Experiment 63. — S. C. 5/4/'03. The subject described the reaction from the sight of a rich purple-colored glass as being very satisfying, rich, and the most esthetic of all feelings, *i. e.*, not organic.

No. of pulses,	5	5	5	5	5
Av. length,	4	4.2	3.9	3.9	4.1

In the above we find comparatively small changes though all except the last show no increase in the frequency of the pulse.

Experiment 64. — L. B. A very unpleasant depressed feeling was caused by inhaling a sickening odor of onion essence three times in succession. The curve is very much lower in height than it usually is and at the same is more rapid. It became stronger just at the time of the second and third applications.

No. of pulses,	5	5	5	5	5	5	5	5	5	5	con.
Av. length.	4.7	4.8	4.7	4.7	4.6	4.6	4.6	4.5	4.5	4.4	4.4
					Very Weak.			Strong.	Weaker.		

No. of pulse (con.),	5	5	5
Av. length,	4.8	5.1	4.8
		Strong.	Weaker.

Experiment 65. — L. B. 5/26/'03. The odor of bergamot was very depressing and unpleasant, the latter effect following the former.

No. of pulses,	5	5	5	5	5	5	5
Av. length,	4.8	4.8	4.8	4.9	4.6	4.6	4.8
					Lower.		

Experiment 66. 4/20/'03. The stimulus was an odor which produced a depressed disagreeable feeling.

No. of pulses, 6 throughout.							
Av. length,	3.5	3.5	3.2	3.1	3.1	3.2	3.6
				Lower.			

Experiment 67. — S. C. 6/1/'03. Castor oil odor caused

the subject to feel very depressed 'brain congealed, life not worth living,' followed by unpleasantness.

No. of pulses, 6 throughout.								
Av. length,	4	4	3.9	3.8	3.6	3.9	3.7	4.1
			Lower.					

The feeling of unpleasantness-repose causes in all cases a decided decrease in the height of the pulse with a somewhat greater frequency, and it is clearly noticeable that the feeling of unpleasantness follows that of repose here as pleasantness and unpleasantness have been seen elsewhere to follow that of excitement.

Summary.

1. The physiological changes in the vaso-motor system accompanying the states of strain and relaxation are as follows. Strain is accompanied by a decrease in the length of the pulse curve, while the dicrotic becomes lower. Relaxation is accompanied by an increase in the pulse length and a heightened dicrotic.

2. The state of attention is accompanied by a feeling of concentration partaking of the nature of strain and has parallel physiological process closely resembling those of strain and relaxation but with less marked and regular characteristics.

3. The breathing in both the feeling of strain and relaxation is more rapid, regular and shallow than in an indifferent state. This is also true of attention accompanied by a feeling of concentration.

4. Pleasantness is accompanied by a longer and higher pulse curve; unpleasantness is accompanied by the reverse.

5. Excitement and repose are accompanied by less marked changes in the vaso-motor system than the other feelings. There is practically no change in the pulse frequency and while the former is accompanied usually by a heightened pulse, the latter is accompanied less frequently by a lower pulse according to my results, but certainly never by a higher.

6. The excitement-strain feeling shows characteristics of the curves of both, while the excitement-pleasure is pretty constant in showing a lengthened and heightened curve. The

curves for excitement-unpleasantness have no constant characteristics. Repose-pleasantness is accompanied by no constant marked characteristics but unpleasantness-repose is accompanied usually by a shorter and decidedly lower pulse curve.

7. Where the feelings are mixed, pleasantness and unpleasantness do not appear until after those of excitement and repose. The time of the appearance of feeling of strain depends on the time it takes for the concentration of the attention to the stimulus. Sometimes it appears almost at once and again two or three pulses later. When it appears in mixed feeling it comes later than the others.

8. The rhythm in the pulse lengths which correspond roughly to the act of breathing, *i. e.*, an inspiration and an expiration, tends to disappear during states of attention and the more so the stronger the feeling of strain and relaxation or of concentration. [1]

[1] The MSS. of this article was received on February 8, 1904.—ED.

THE PSYCHOLOGY OF ÆSTHETIC REACTION TO RECTANGULAR FORMS.

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Since the æsthetic value of the golden section was first developed by Zeising,[1] all questions in the psychology of the æsthetics of form have centered around this one, the psychology of the golden section. And to-day it is as much an open question, why we like the golden section, as it was when Fechner wrote,[2] "If you ask me, I simply say, I do not know." Fechner's researches showed that the golden section was not so nearly the universal choice as had been claimed. His measurements of many thousand paintings, and the results of choices, amongst ten cards of different proportions, made by several hundred men and women, show, however, that the preponderance of choices is near the golden section. Witmer's[3] investigations emphasize the importance of the relation in both the rectangle and the ellipse, and also in the division of lines, and in relations of separate lines to one another. Angier's[4] results likewise indicate its importance in the division of the horizontal line. But the evidence is not sufficient for suggesting an exact law; it is not as strong, *e. g.*, as it was in favor of Weber's law. In fact Fechner says that his 'results for every class of pictures show that the relation of the larger to the smaller dimension is on the average much less than that of the golden section.' ('Welche Bilderklasse man ins Auge fassen mag, das Verhältniss der grösseren zur kleineren Dimension durchschnittlich viel kleiner als das des goldenen Schnitter ist') (*i. e.*, to make the golden section, the large ought to be larger, or the small, smaller).

[1] *Æsthetische Forschungen*, 1855.

[2] *Vorschule der Aesthetik*, 1876.

[3] 'Der Experimentellen Aesthetik einfacher räumlicher Formverhältnisse,' *Philosophische Studien*, 1894.

[4] *Harvard Psychological Studies*, Vol. 1, pp. 541 ff.

So much for the facts. On the side of explanation we meet a much greater variety. It is therefore the least satisfactory aspect of the problem, and the one that calls most loudly for serious constructive work.

1. To pass proposed explanations of this class of phenomena briefly in review, we may mention, first the theory which proposes the *mathematical relations* of the lines, as the ground of preference. The rectangle whose sides are in the relation of extreme and mean ratio, is pleasing because of the simplicity of the process by which the variety here offered is grasped as a unity. The smaller being in the same relation to the larger as the larger is to the sum of the two, gives us the simplest possible concept of an organism. It presents a pleasing variety, which of itself, by virtue of the simplicity of its mathematical relations, leads the mind to the idea of unity. Hence Zeising saw in the golden section, 'the complete embodiment of an ultimate æsthetic principle — the combination of a complete diversity in an harmonious unity.' This theory is closely analogous to the one which explains musical harmony on the basis of an unconscious counting of vibrations. Both are open to the same objection. Psychology knows nothing of unconscious cerebration. But the mathematical explanation of the golden section, fails for another reason; considerable deviations from the golden section, are as pleasant as it itself is, to most people. Thus there is nothing analogous to the dissonance arising from beats, in tone.

2. Various attempts have been made at a physiological explanation of æsthetic problems. First suggested by Schiller,[1] it has been developed by Spencer,[2] Bain,[3] and Allen.[4] In general it holds that the æsthetic gratification in any form of activity, depends upon the condition of the whole nervous system, or at least of all parts more immediately concerned in the reaction. Surplus energy, consequently, is the essential physiological condition of an æsthetic reaction. But a discharge of the surplus energy of a given organ, *e. g.*, of the retina is,

[1] *Letters upon the Æsthetical Education of Man*, Letter 27.
[2] *Principles of Psy.*, Part IX., ch. 9.
[3] *Emotions and the Will*, 1859. *Mental and Moral Sciences*, 1868.
[4] *Physiological Æsthetics*, 1877.

in itself, insufficient to bring about an æsthetic feeling. The arousal of an æsthetic feeling connected with the visual processes, depends upon the relative amounts of stored energy or freedom to discharge, throughout the whole visual apparatus. It involves, at the minimum, retinal, eye-muscle and cortical processes. The main defect of this theory is, that it does not loan itself to concrete application. It is too general to be of service in actual explanation. It cannot be applied with profit to the explanation of pleasing rectangular forms.

3. A far more serviceable theory is that which may be called 'explanation through association.' Its adherents say that we like a given form because of its resemblance to forms to which we are already accustomed. Books, cards, envelopes, panels, windows, etc., are made in shapes which are determined by the purposes they are intended to serve. There are pretty definite upper and lower limits, beyond which these forms do not proceed. There is also a proportion of the sides, which is more convenient in these objects, and which is embodied in a very large number of them. We get accustomed to these forms; a facility in reacting to them is established; and the majority of people react most favorably to the proportions predominating in the environment in which they live. We like therefore what we have seen most frequently, because of the facility of its apperception. This makes the æsthetically pleasing the predominantly useful. Its use determines its prevalence; and this in turn, determines the facility of its apperception, and this again determines its power to engender æsthetic feeling. The possibilities are that the reaction will be only slight if it is agreeable, but if it be a disagreeable or unpleasant reaction, it will be much more positive and intense. The reason for this is that the nerve paths are less obstructed, and so lead to a ready apperception.

4. Again it has been proposed as a specific explanation of the pleasantness or æsthetic quality of a proportion, or asymmetrical division or relation, that it is in reality a symmetrical division or relation. In order to take pleasure in an asymmetrical division of a horizontal line, we have to supply mental material to the shorter end, in order that it shall come up in

weight, so to speak, to the longer. The weight is a weight of attention. From a meaning read into the shorter line, — say a purpose that it is subserving, — it is occupying an equal share of the attention with the longer line, and the two parts do really balance for the onlooker. It is the same explanation which sees in so many pictures a large object on one side, balanced and compensated for, by the direction of the attention of the onlooker to the other side, by leading lines, or the gaze of a human subject. The physically unsymmetrical is shown to be the psychically symmetrical.

5. Another theory accounts for the enjoyment of beautiful objects, by movements of attention and imagination, coupled with activity of comprehension and sympathy. Applied to our own problem, this means, that in lines there is a wealth of pleasurable association, of a kind that connects them with movements, which we admire in living things. These movements are those which suggest unconstrained activity. Besides this ethical motive, the intellectual motive of comprehension enters also as an explanatory feature of æsthetic pleasures. By comprehension is meant the possibility of bringing a form, *e. g.*, a line, under a single law throughout, so that it may be understood. We see very soon what its intention is. The successive parts have novelty, and yet in the end realize the expectation aroused. "The mental formula or conception gained early in our perception of a line, is found throughout to apply." Another factor is the organic reaction which the movement and life attributed to the figure, gently stimulate. Alteration in the breathing and circulation, rhythmic change in tension of groups of muscles of the limbs, neck, and trunk, accompany attention to the change in the imaginary point along the observed figure. Organic factors are however, only secondary; their function is to react upon the complex mental state, giving it 'body.' The object of our æsthetic enjoyment, is not given in sense, but in a spiritual construction out of material, which is often the very opposite of æsthetic. Elementary æsthetic pleasure has the same factors as our highest enjoyments and involves the awakening of intellectual, ethical and religious ideas. If graceful form does not

arise directly out of our ethical and religious nature, it does from something akin to it, namely, our sympathy with well ordered action and love of participation in such action.

Each of these theories possesses elements of value, but no one of them is sufficient. Such an array of contradictory theories, is surely warrant enough for making a new excursus into the field of the psychology of the æsthetic reaction. In order to work within a narrow and yet quite typical field, the present investigation confines itself to rectangular forms. This is a desirable form to work with, because it puts the investigation in line with what work has been already done in the same field, and thus provides a means for checking results. But it is an important figure for another reason. Limitation of material is important in questions of this kind. Witmer has lost some advantage that might have followed his method, by a lack of discrimination among the selected forms studied. Take, for example, the group in which the rectangle appears. It is put with the triangle and ellipse only because they are all 'enclosed figures.' It does not appear however, that they are all equally simple forms. Moreover, whether they are capable of evoking an equally primitive reaction æsthetically cannot be decided previous to investigation. We have taken one figure of this group, thinking it well to keep the investigation as individual as possible. We have chosen the rectangle in preference to the other figures, because it is, as an object, simpler than the other two; there are fewer distractions for perception in it, there is consequently, less hindrance to the emergence of a purely æsthetic response on its first presentation. The individuality of our problem lies in the fact that one of the simple space forms, and one that is constantly recurrent in experience, has been selected and submitted to experimental treatment, with an aim to define its æsthetic suggestibility.

Throughout the investigation, it is a matter of importance to ascertain what figure is selected out of the series of rectangles constructed on the same base, but varying in width, up to and including the square. Is it the rectangle whose given sides are as the golden section? In any given case, or number of cases, do the judgments cluster around the golden section, as they do

with Fechner's and Witmer's observers? But more important still, is an insight into the mechanism by which the choice is made. This inquiry was couducted so as to lead into the field of explanation.

II.

The methods of Fechner and Witmer were neither of them satisfactory. Fechner used ten cards, each having a surface of six hundred and forty square centimeters. Beginning with the square, the relation of the sides was as expressed by the following fractions: $\frac{1}{1}$, $\frac{6}{5}$, $\frac{5}{4}$, $\frac{4}{3}$, $\frac{32}{25}$, $\frac{3}{2}$, $\frac{34}{21}$, $\frac{23}{13}$, $\frac{2}{1}$, $\frac{5}{2}$. These were placed at random on a blank surface, the cards being white, and the observer made a choice of one, if possible. Sometimes two or more were chosen as equally satisfactory. In such a case, 50 per cent., 33⅓ per cent., etc., was put down for each one so designated, and thus the individual's choice was distributed in making up the average. Now an objection to this method is, that that the rectangle which is pleasing in one position, often fails to satisfy when turned 90°. Another objection is that the judgments as to whether or not one likes a given figure, must be comparative under these circumstances. Judgments should be made as far as possible, in isolation from other objects of the same kind. The distraction also incident to having many shown at the same time, should be avoided, thus securing uniformity of attention to each.

Witmer met the first objection by placing his cards in serial order, and all in the same position relative to the same observer But the comparisons and distractions were still incident in his method. To avoid all three of these objections, we showed the cards, one at a time. We placed the white card on the black paper on the table before which the observer was sitting and asked him to accept or reject each one in turn by a definite act of pushing it away, or taking it into his hand. This action called forth definiteness of choice in many cases which was a surprise, even to the observer himself. This was perhaps, the most significant factor in our method, different from the other two mentioned.

The advantages from this method, over that of Fechner's and Witmer's, may be set forth in detail:

1. *The Advantage of a Clear Objective Field of Vision.* — The accepted and rejected figures are removed to one side and do not enter into competition with the last presented figure. The advantage of this is to reduce the element of distraction to a minimum, and to have attention free to react upon the presented form. Both of these are absent from the method of both Witmer and Fechner. We do not, however, exclude the comparison of one figure with another in the same group as an aid for judgment, but this is found necessary only when, for special reasons, the mind has wandered from the matter under determination.

2. *The Advantage of Serial Presentation.* — Under this condition, each figure makes its own impression — is presented to consciousness in an unprejudiced way — and yet does not enter consciousness as an isolated or stray fact. Continuity within the whole range of facts, covered by a series, is secured, thus making change an element of the objective facts, not of subjective attention, as is the case with Fechner and Witmer. And the relations of every new fact are already laid down by the mental disposition aroused by the serial order. In all this we have a marked approach to conditions of normal life where, for example, our interests tend toward groups, and the continuity of conscious experience lies within these larger areas.

3. *The Advantage of the Motor Element.* — The subject was allowed to take any card in his hand about which he might be in doubt, and frequently a decision was arrived at very quickly. Also in connection with each judgment, whether it was favorable or unfavorable, the motor factor was introduced with the removal of the card from the field of vision. We claim this had the advantage of naturalness. Our judgments are, for the most part, expressions of motor significance.

We used, in all, four series of cards. In each series the length remained constant, the width alone varying. The sizes follow:

Series 1, length 80 mm., width from 25 mm. to 75 mm. by 2.5 mm. steps.

Series 2, length 90 mm., width from 25 mm. to 85 mm. by 2.5 mm. steps.

Series 3, length 100 mm., width from 25 mm. to 95 mm. by 5 mm. steps.

Series 4, length 120 mm., width from 25 mm. to 115 mm. by 5 mm. steps.

The following tables (I. and II.) present results obtained from the use of the cards. The numbers 80, 100, etc., indicate the length of the cards. The word 'horizontal,' means the card was so placed before the observer that its longest dimension was parallel to the line joining his eyes. 'Vertical,' was at right angles to this position, and in the same plane. The figures in the column mm., give the widths of the cards chosen, in millimeters, and those in the percentage column, give percentage relations of these widths to the given length.

TABLE I.

Obs.	Length 80 mm.				Length 100 mm.				Length 120 mm.			
	Horizontal.		Vertical.		Horizontal.		Vertical.		Horizontal.		Vertical.	
	mm.	%	mm.	%	mm.	%	mm.	%	mm.	%	mm.	%
Cr.	25.0	31	27.5	34	25.0	25	40.0	40	30.0	25	30.0	25
	27.5	34	37.5	47	50.0	50	70.0	70	75.0	63	50.0	42
	60.0	75	60.0	75	90.0	90			110.0	92	60.0	50
											75.0	63
Da.	50.0	62	55.0	68	65.0	65	75.0	75	80.0	67	85.0	71
Ec.	30.0	37	67.5	84	25.0	25						
	55.0	68	70.0	87	35.0	35	65.0	65	35.0	29	105.0	88
	75.0	94	75.0	94	90.0	90	90.0	90	105.0	88	110.0	92
					95.0	95	95.0	95	115.0	98		
He.	35.0	43	35.0	43	50.0	50	95.0	95	65.0	54	115.0	98
	57.5	72	57.5	72	95.0	95			115.0	98		
Ho.	37.5	47	30.0	37	45.0	45	40.0	40	55.0	46	45.0	38
	42.5	53	25.0	34					50.0	42	50.0	42
Ke.	40.0	50	70.0	87	45.0	45					70.0	58
	45.0	56	40.0	50	60.0	60	60.0	60	80.0	67		
					85.0	85						
Mal.	45.0	56	75.0	94	55.0	55	95.0	95	60.0	50	115.0	98
	55.0	68			70.0	70			75.0	63		
	75.0	94			95.0	95			115.0	98		
Mas.	40.0	50	40.0	50	55.0	55	55.0	55	60.0	50	60.0	50
	62.5	76	62.5	76	80.0	80	80.0	80	70.0	58	70.0	58
My.	42.5	53	42.5	53	50.0	50	55.0	55	70.0	58	70.0	58
					60.0	60						
Pe.	27.5	34	37.5	47	45.0	45	45.0	45	45.0	38	45.0	38
	37.5	47	57.5	72	55.0	55	55.0	55	70.0	58	60.0	50
	75.0	94	60.0	75								
			75.0	94								
Re.	40.0	50	70.0	87	45.0	45	65.0	65	35.0	29	90.0	75
					50.0	50			50.0	42		
					65.0	65			80.0	67		
					85.0	85			90.0	75		

TABLE II.

Observer.	Length 80 mm.				Length 90 mm.			
	Horizontal.		Vertical.		Horizontal.		Vertical.	
	mm.	Per cent.	mm.	Per cent.	mm.	Per cent.	mm.	Per cent.
Ra.	35.0	43	35.0	43	40.0	44	40.0	44
Mc.	27.5	34	25.0	31	32.0	35	25.0	27
N.	30.0	37	27.5	34	27.5	30	30.0	33
Sh.	62.5	78	52.5	65	65.0	72	65.0	72
L.	35.0	43	60.0	75	65.0	72	50.0	55
Sc.	40.0	50	70.0	87	35.0	38	25.0	27
							80.0	88
T.	32.5	40	25.0	31	30.0	33	32.5	36
Ha.	50.0	62	47.0	58	55.0	61	60.0	66
	52.5	65	50.0	62	57.5	63		
	55.0	68	52.5	65				
Po.	42.5	53	50.0	62	57.5	63	57.5	63
Do.	70.0	87	70.0	87	80.0	88	80.0	88
Pa.	37.0	46	25.0	31	32.5	35	30.0	33
	40.0	50	27.5	34	37.5	41	32.0	35
	42.5	53	30.0	37	40.0	44		
	45.0	56	37.5	40	42.5	47		
					45.0	50		
Ko.	45.0	56	52.5	65	80.0	88	80.0	88
	67.5	84	55.0	68				
	75.0	93	60	75				
			62.5	78				

A superficial examination of these results, is sufficient to convince one of the absence of any single principle determining the choices of these various observers. Indeed the results given by a single observer, as Ec. or Mal. shows that very different types are liked equally well. This is what is to be expected, if we are controlled in making such choices, by the associations we connect with such forms. That association does play a conspicuous, if not an important part, is borne out by the introspections. The observer likes two or more very different forms because of the different purposes which they subserve, and different uses which they suggest.

Thus, we find that the introspective notes reveal quite distinctly, that the reason for liking any particular figure or group of figures is, either (1) because of the similarity of the proportions of the chosen figure to those of figures met with previously, or (2) because the chosen figure fits in with a group of interests already developed in the case of the individual observer. As examples of the former, we may cite cases in which there is a likeness to 'calling cards,' 'note books,' 'writing tablets,'

'posters,' 'looking glasses,' etc. As an example of the latter, one observer says, that a given proportion of sides is good 'because she would choose it for a canvass on which to paint a marine sketch.' This observer paints marine scenes. It is thus not merely likeness to other canvasses which have been seen, but the arousal of personal interests that determine particular choices. Another prefers given rectangles because they are the 'figures he likes to deal with in geometry.'

Beside these two general types of motive, we find also other influences, which, while not so widely distributed, are sufficiently prominent to deserve separate mention. (3) Solidity and completeness, give rise to certain of our æsthetic judgments. This is the case when a rectangle is spoken of as 'complete in itself,' or 'has wide enough base to hold it up,' or when it produces the feeling that it can be 'left alone.' (4) A complication of motives often determines such choices. If a rectangle suggests a panel, its selection is due to familiarity; but if, in addition, it is a panel suitable for the 'Gibson girl with a curl over her shoulder,' the limitation of use to which the panel is to be put, is imposed by the personal interests of the individual. These introspections indicate that the results here presented, are not wholly lawless, as might appear at first sight, and at the same time they point out the direction in which an explanation is to be sought. Two individuals may like different figures because they are controlled by different motives. In the same way, different grounds of choice, determine the same person to like two very different figures equally well. Looking at the tables, we readily see examples of what might be called type-selection, rather than individual-selection. *E. g.*, Ec. in Table I., shows clearly at least two types, in every series. So also do He., Mas. and Pe. Pa. of Table II., is a good case of many choices, but all conforming to a simple type. All four of these, in the first column, *e. g.*, ranging in width from 46 per cent. to 56 per cent. of the height, are equally satisfactory and for the same reason.

The evidence, however, for the existence of types, is yet stronger from the introspective notes. Some observers come with preferences ready formed, but not well defined, so that

anything within certain fairly wide limits suits them. The figures conform more or less closely to what they demand. The observer says, *e. g.*, 'I always liked figures with even sides,' or 'These are exact proportions, in other words, a rectangle whose width is about half its length,' or 'a rectangle must be longer than twice its width, and shorter than three times its width.' It is often harder for the observer to select a given figure, than it is to say that five or six suit him. In other words, the group is easier selected than is a specific figure. But as you progress in a series, there comes a limit somewhere, that marks off this type from others; it is the limit of forms capable of being assimilated under the ruling concept. If choices are made beyond this, they are determined by other motives and belong to other types. Thus there are comparatively wide limits to a type, and yet types are clearly discriminated in given individual observers, and between individuals.

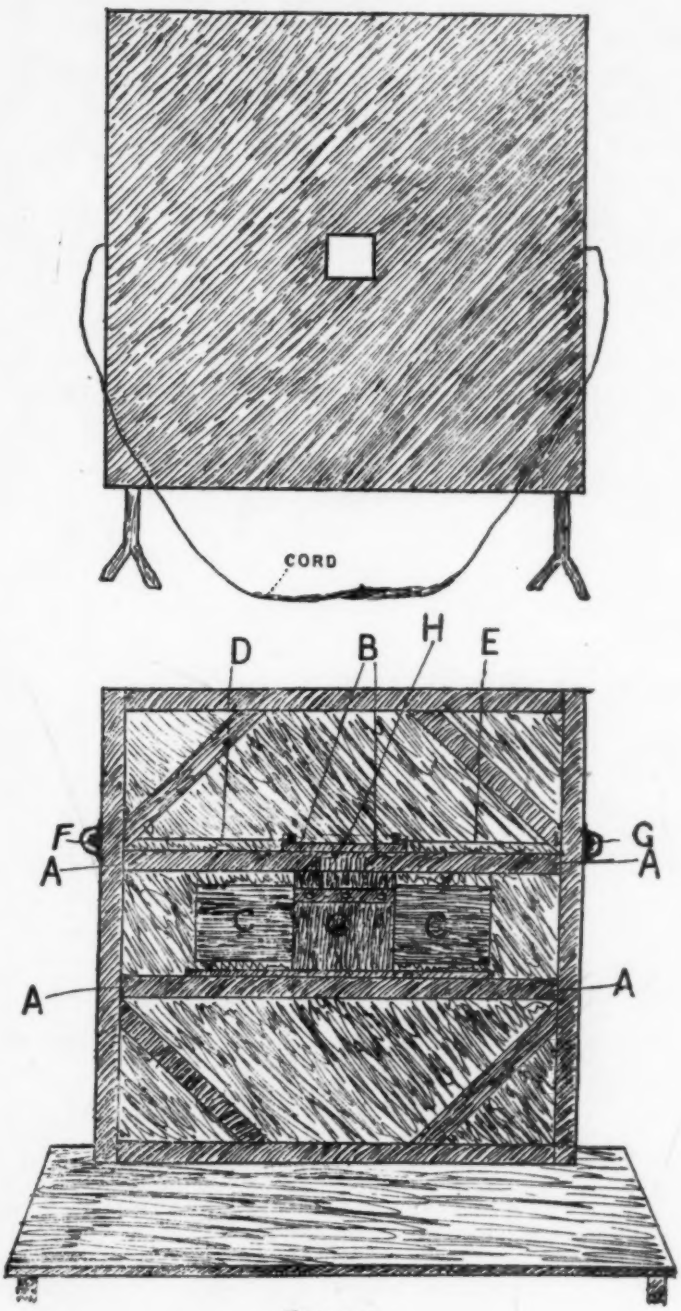
These facts in regard to types, show the improbability of the golden section being the æsthetic norm. They also point out the error of applying the method of averages to such results. To use the method of averages, in cases where such significance attaches to individual results, is indeed to kill the goose that lays the golden egg. So far from being a source of embarrassment, these variations themselves contain not only their own explanation, but in them is to be found the germ of the explanation of this whole class of æsthetic judgments. The variations then must be preserved. The method of averages, as applied by Fechner and Witmer, vitiates their results.

But the apparatus and the method of experimentation with cards, also come in for a share of criticism. The steps in the series may be too wide. *E. g.*, in Fechner's series of only ten cards, there are probably many cards left out which some observers would prefer to any that are given. The same holds of Witmer's series and our own. Clearly the ideal apparatus for this experiment, would permit the observer to make his own figure.

We used a piece of apparatus (see Fig. 1) which allowed of this possibility. It consisted simply of a screen of black

card-board set up in a vertical position, 1.3 meters from the eyes of the observer, when he was sitting in a chair fixed to the floor. This screen was one meter square. In the center of the screen was an opening 10 centimeters square. The center of the opening was on a level with the observer's eyes. A simple mechanism provided a means of moving a black card across the opening, behind the screen. As a part of the frame to which the black card of the screen was fastened, there were two horizontal strips, *A* (Fig. 2), about 25 centimeters apart. Vertical saw slits were cut in these. A slide, *B*, rested upon the upper one of these pieces, and a card *C*, fastened to it, and depending through the slits, moved back and forth from side to side of the frame behind the window from the observer. Cords *D* and *E*, from either end of the slide, passed through pulleys, *F* and *G*, at the sides of the screen, and thence to the hands of the observer on the other side. The depending movable card was white, but in its center was pasted a black card, more than wide enough to cover the opening in the screen. The edges of this were exactly parallel to the opening of the screen, so that on whichever side of the opening it might be, right or left, some of the white card was exposed. Thus the figure presented to the observer, in white, was an exact rectangle. A millimeter scale, *H*, on the back of the screen, afforded a ready means of measuring exactly, from behind the screen, from right or left, any width of figure the observer might give. The work was done in a dark room, the only source of light being a sixteen candle power light held in a box directly above and behind the observer. Light was emitted through a three-quarter-inch hole, and even this was covered with tissue paper (Figs. 1 and 2).

By this simple apparatus it was possible to secure the motor reaction on the part of the observer, which had been found so useful with the cards. The observer had it in his power to modify the width of the figure within the limit of 10 cm., by any minutest step which he could perceive. Moreover, it was possible to go over uninteresting parts of the series with haste, thus avoiding fatigue, gaining time, and obtaining results with a more constant state of attention. The apparatus also provided a ready and efficient means of obviating two sources of



FIGS. 1, 2.

error which it itself might seem to introduce, namely, (1), by the direction of approach from right and left, and (2), direction in the series, *i. e.*, increasing or decreasing width. Each of these was obviated by the method of reversal. We approached the question always in the four ways thus made possible:

1. Closing in from a white square from the right.
2. Closing in from a white square from the left.
3. Opening out from an all black from the right.
4. Opening out from an all black from the left.

Tables III. and IV. present results given on this apparatus, with these four variations, by the same observers whose results with the cards are presented above. The results given are widths in millimeters for the four movements. The length was 100 mm. in all cases. The results therefore are also percentage values of widths in terms of length.

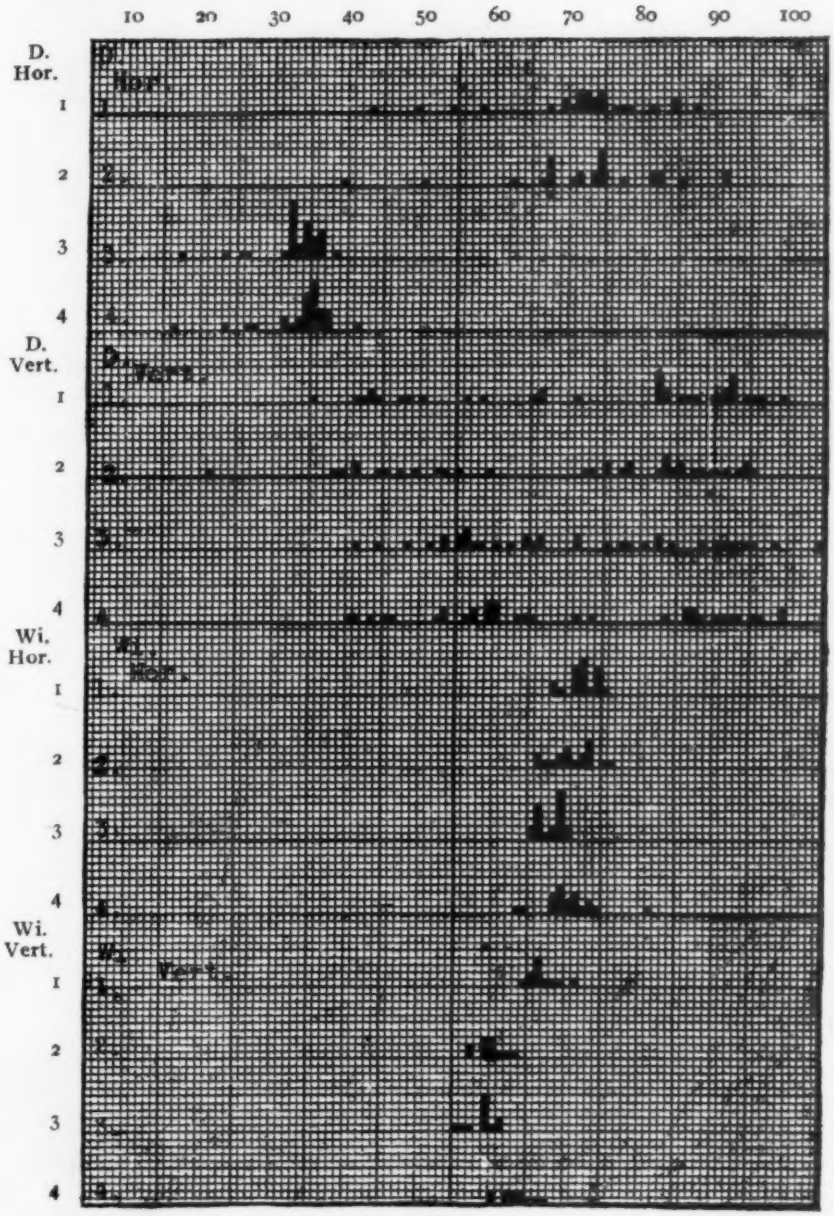
TABLE III.

Obs.	1	2	3	4
Cr.	62.5	55.0	56.0	45.7
Da.	65.5	61.0	54.0	55.0
Ec.	100.0	93.0	96.0	96.0
	57.0	100.0	53.5	67.0
He.	92.0	97.0	93.0	93.7
	53.6			
Ho.	54.7	50.5	49.5	53.6
		68.0		
Ke.	51.0	51.3	49.3	49.0
	49.5	47.5	45.0	45.0
Mal.	64.0	70.0	75.0	71.0
Mas.	56.0	70.0	22.0	45.0
	65.0	57.5	27.5	31.8
My.	62.0	68.5	66.0	64.5
Pe.	73.0	73.0	44.0	48.8
Re.	72.0	61.0	59.0	50.0
	63.0	61.0	38.0	47.0

TABLE IV.

Obs.	1	2	3	4
Ra.	41.0	36.0	21.0	28.0
	50.0	54.0	31.0	41.5
Mc.	39.0	43.5	27.0	26.0
	48.5	55.5	32.0	28.0
N.	62.5	46.5	26.0	25.0
	33.0	33.0	49.5	34.0
		23.0		47.0
	45.0	43.0	42.0	43.0
Sh.	76.5	64.0	81.5	76.5
L.	36.0	56.0	30.0	59.0
Sc.	51.5	56.0	52.0	48.0
	72.0	49.0	41.0	49.0
T.	42.0	56.0	45.0	44.0
	46.0	45.5	46.5	44.5
Ha.	64.5	65.5	70.0	70.0
	67.5	68.0	69.0	63.0
Po.	61.5	57.5	58.5	55.0
	41.5	39.0	56.0	52.0
Do.	87.7	85.5	84.0	83.0
	85.0	83.0	86.0	87.0
Pa.	55.0	45.5	28.5	22.5
	38.5	33.5	24.5	24.5
Ko.	57.5	81.0	91.0	80.5

Some advantages for this apparatus and method, already anticipated, come out in the results here presented. Greater facility in making a definite choice is secured. An observer who gave five cards near together as being equally desirable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100
D. Hor.
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3
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D. Vert.
1
2
3
4
Wi. Hor.
1
2
3
4
Wi. Vert.
1
2
3
4

CHART I.

would here give one as his choice: *i. e.*, one can more easily make his choice, here, among several that belong to the same type. It is evident, too, that sometimes a type is chosen very different from any given by the same observer with the cards. This is explained by the remarks of several observers. *E. g.*, one says he is 'less limited by material here.' A card is a card; but here he is interested in form, as such. Again Ec. selects two types: the square, and one about 67 by 100 mm. The square she says, she 'just likes,' but the other form she says 'would be a good form for a card if you dared have it.' She was able to see it more purely as form. On the whole, it is evident that the problem before us is more purely one of form. The observer feels less hampered by the conditions, and arrives at more definite judgments.

But the more serious and extended study of the problem is yet to be reported. In it, we confined ourselves to this apparatus. Altogether, there are seven observers whose results are reported on the apparatus as above described in the horizontal movement of the shutter. The screen was then turned 90°, making the slide move up and down, thus giving the four movements.

1. Closing from above. (Start with white square.)
2. Closing from below. (Start with white square.)
3. Opening from above. (Start with all black.)
4. Opening from below. (Start with all black.)

In this part of the work, there were in all, twelve observers. Some of these worked an hour a week for several months. Others worked only a few hours altogether. The amount of work done by each observer is readily seen from the charts, since each blackened square stands for a judgment. These blackened squares indicate by their position what was the width of the figure preferred, since there is a space for every millimeter of possible width. It has also seemed worth while to preserve the absolute results, even with regard to each one of the four ways of approaching the problem, since these are so strikingly different in some cases.

In Chart I., under D. (observer) Hor., we find the results presented as given by D. in the horizontal movement, for 1, 2,

3 and 4 as above explained. In (1) closing in from a white square from the right, *e. g.*, we find he stopped once at a figure 39 mm. × 100 mm. But he gave most of them between 63 mm. and 80 mm. wide, giving three each at 67 mm., 68 mm. and 70 mm., none at 71 mm. and one at 72 mm.

It is apparent at once in looking over the results indicated in these tables that all the observers had quite different choices. It is to be remarked that those observers who worked most with the apparatus give the most scattering results; and in the case of one, D., where the height of the figure was changed, 'vertical,' the choices are more widely distributed than in horizontal, indicating decreased definiteness of choice. This, however, is not to be taken as the natural effect of continued work. It is explained in large part by an illusion of which he found it very difficult to rid himself. The same holds of H., in a lesser degree. This also was due in some measure to the same illusion. In both these cases the *direction* of movement was responsible for the scattering only in so far as it was responsible for these illusions. Wi., Wa. and J. are the three other observers whose results give us good ground for comparison of results in vertical and horizontal movements. None of these show any considerable increase in scattering in the "vertical." All are clearly indicative of definiteness of choice, under a single motive. K. 'vert' is another example of scattering results. It was very noticeable in the case of this observer that, as the work proceeded from week to week, his limits of choice narrowed down. It is safe to say that, in the last three hours of work with him, all his choices fell between 38 and 48 mm. On the other hand, the increasing scattering with H. and D. are no doubt due to the increasing number of motives determining choices.

In general, the results show definiteness of choice. Where two motives rule, the ground between the two groups is pretty clear. See, D., 'Hor.,' and H., 'Hor.' Difference of types, where two occur in the same observer, and in different observers, comes out more significantly than in the card results given above. It is pertinent here again to ask the question, What would be gained by averaging the results of H., 'Hor.' to find how near his choice fell to the golden section? Or what would an aver-

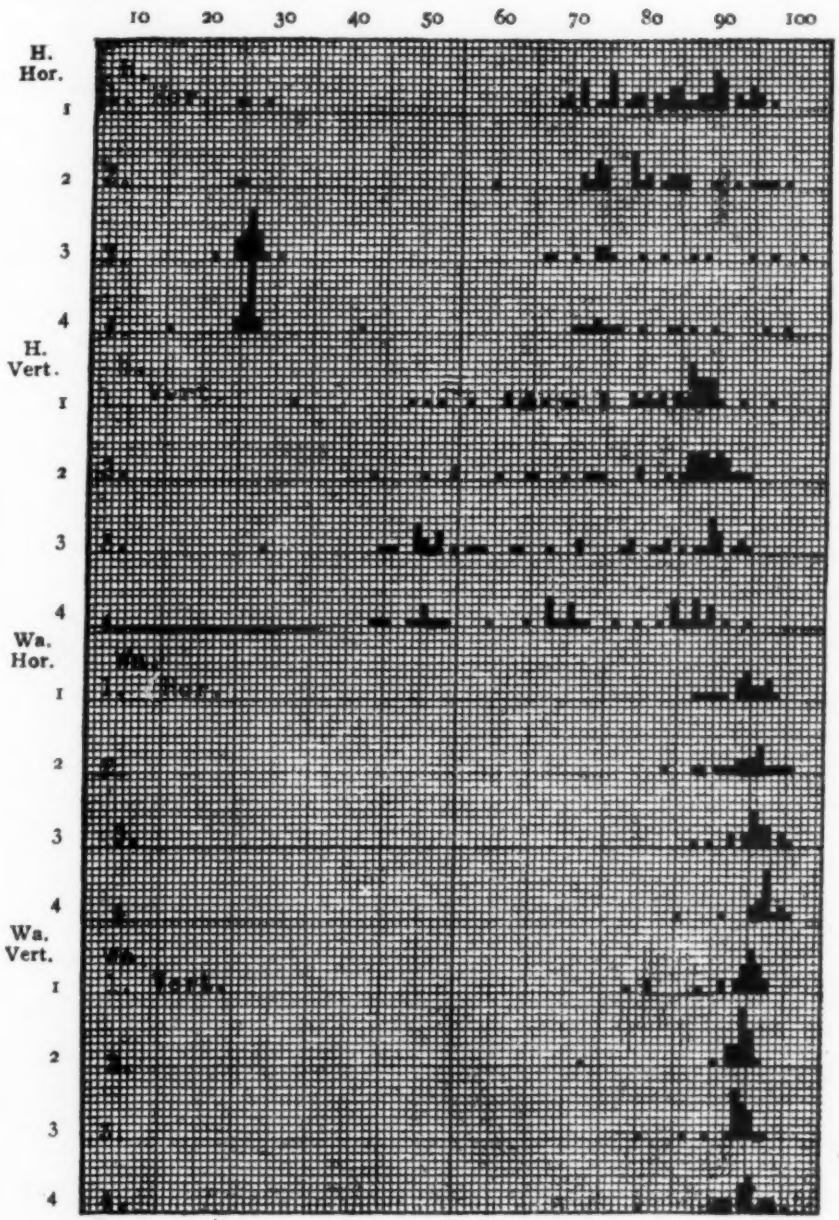


CHART 2.

NOTE. The uppermost row of figures should be *on* the base line, 1. Hor.

age of the results of Wa. and J. indicate? Of what imaginable use could such results be?

The existence of two types in the same observer, for one position of the apparatus, is clearly shown by D., 'Hor.' and H., 'Hor.' Both come to a wide one which they like 'closing in,' in movements 1 and 2, and to a narrow which is equally satisfactory, 'opening out,' in movements 3 and 4. This interest in two types from the first in these observers is worth considering in relation to the later development of still other types. O. also has a clear leaning to wide ones for movements 1 and 2, and to narrow ones for movements 3 and 4. He said 'he would like the narrow ones better in 1 and 2' if he could 'content himself to come to them.' H. is an example of overcoming the interest in the narrow one, in about half the judgments in movements 3 and 4.

Another point of interest here is the relation between the ratios of the two dimensions of the figure when the movement is horizontal, *i. e.*, height is greater than the breadth, and when the movement is vertical, *i. e.*, breadth is greater than the height. Fechner found in his measurements of pictures that Genre pictures, whose height was greater than breadth, had a normal size of 1.202 by .992 Prussian feet, or ratio *1 : 82*. Genre pictures whose breadth was greater than height were 1.737 by 1.389; ratio *1 : 78*. Landscapes, height greater than breadth 1.890 by 1.330; ratio *1 : 70*. Landscapes whose breadth was greater than height, 2.271 by 1.571; ratio *1 : 68*. These results were the product of very extensive averaging, as already explained, and they were not very far apart. Our more intensive study of a few individuals presents no clear evidence for the one side or the other. Wi. and L. clearly prefer a narrower figure when it is turned on its side, *i. e.*, their figure whose height is greater than its breadth presents a smaller ratio of shorter side to longer than do their figures whose breadth is greater than height. The former for Wi. are about 65 by 100, and the latter about 57 by 100. This is in Fechner's direction and more so. But H. 'vertical,' compared with 'horizontal,' shows a clear widening of both types; J. also shows a clear broadening of the figure (one type) when the figure is turned 90°; D., even with this scat-

tering, shows a clear broadening of both types; Wa. is practically the same in both series.

III.

We turn now to a classification of the motives leading to the choice. These are shown by the introspections of the observers themselves. They come in answer to questions both as to why they like those they do like, and why they do not like various unpleasant figures which they either make themselves or which the experimenter gives them. These are often very productive. Now these reactions of pleasant and unpleasant character are, of course, relatively simple likings and dislikings. They are simple reactions of an observer to a comparatively simple content. In any such case it is natural to find the reasons for liking, sometimes placed in the object and sometimes expressed in subjective terms. Thus the figure is now satisfactory in itself and now satisfactory because it fits in with a particular purpose of my own, or it conforms to an ideal proportion of mine.

This we make the basis of our first division of motives to choice. We find five classes, as follow. They form a convenient though not strictly a logical division of motives.

1. Motives found in the object. These are what may be called pure æsthetic judgments of simple type. The figures, so judged, seem good in themselves. We do not want to do anything with them. In the other classes the observer does want to do something with the figure, or it expresses what he wants to do.

2. The figure soon *grows* from the *immediate interest* of (1) to a definite suggested use. These we call *suggestive*. Emotion and apperception function in these cases.

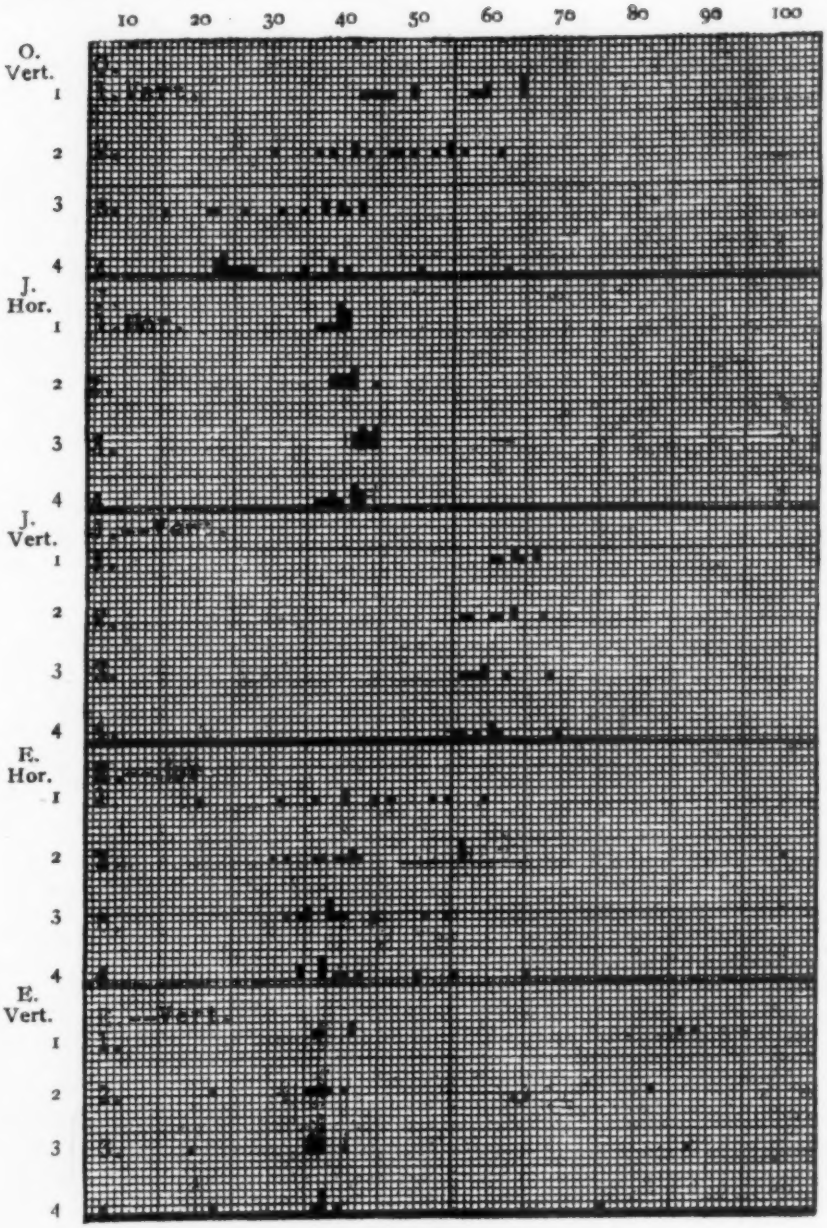
3. This apperceptive element precedes the reaction. There is a preconceived ideal, as *e. g.*, in the ordinary association. Expectation is *definite*.

4. Simple sensory elements, sometimes illusions, make for pleasantness or unpleasantness of the figure.

5. A pure motor element comes into prominence.

The notes will explain these.

1. In giving 30.6 immediately after 70, D. says, "That's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J.
Vert.
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E.
Hor.
1
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3
4
E.
Vert.
1
2
3
4

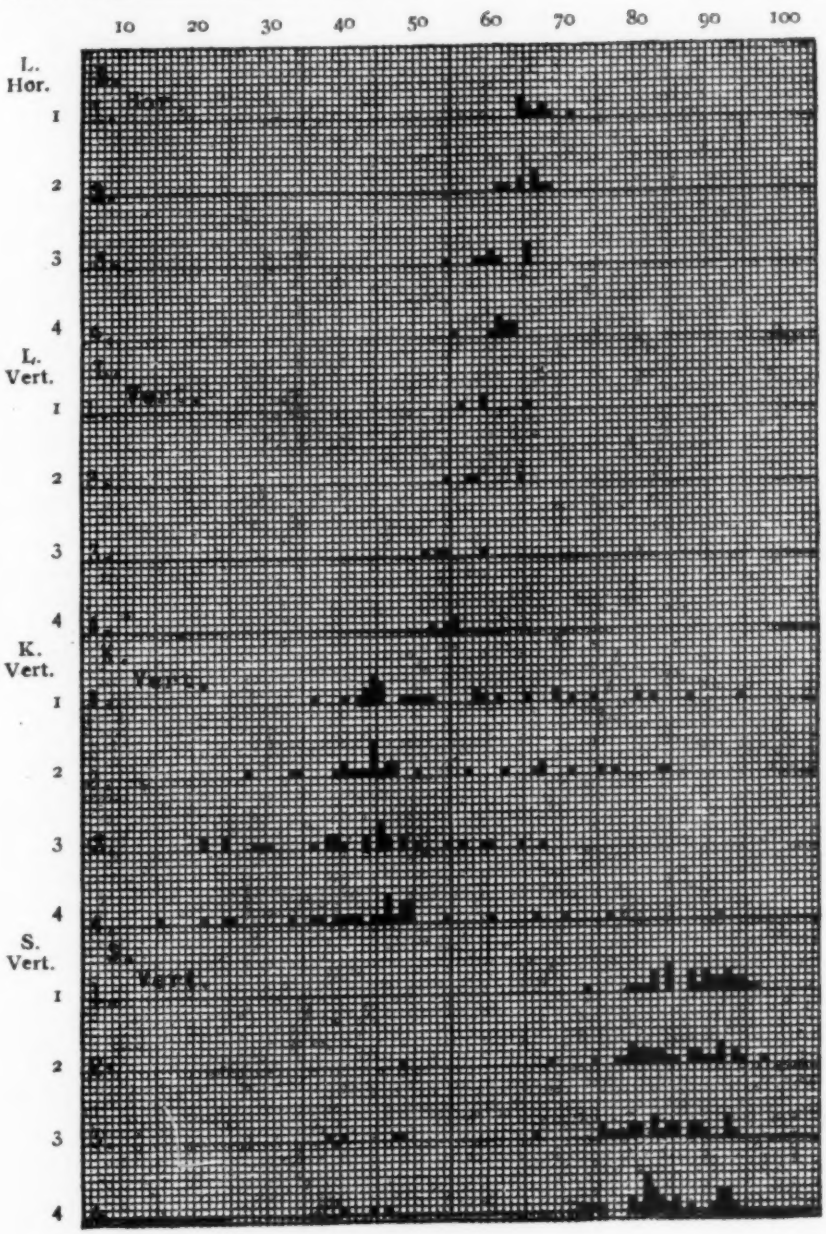
CHART 3.

easy. I like it for itself. I wonder now how I like the broader." Again he says, 'there is an absence of demands.' Again, 'there is here a permanence of mood.' He mentions pulses of feeling as he moves the shutter in. These, however, he finds occur at definite places in the scale, as he tries it with different rates of movement. Many observers use such expressions as the figure is 'easy,' it is 'comfortable,' 'it is neat,' it 'fits in,' it is 'complete in itself.' Again, 'It is open and has variety,' say D. and K. 'The lines differ, and are yet in harmony,' says L. 'It is substantial.' H. says of 67 'vertical' that 'it is substantial and complete in itself.' He says "that 75 as compared with 90 'horizontal' is pretty satisfactory"; 90 is 'too clumsy.' D. says of 70, 'It is too bulky, but I could spare very little.' L. says, 'The square is too bulky and has too much sameness about it.' Moving horizontally to 35, D. says 'all wider ones are too squatty,' by which he seems to mean they are too wide for their height.

2. This class is the direct outcome of 1. In fact it is often hard to assign a given case. These cases the observers describe as being 'sudden discoveries.' They are seized with a liking for a figure, which was totally unexpected. "It was an arrest, I had to do the stopping myself." They had failed to find anything in it before. An 'immediate liking' for it which is not coördinated with any preconceived ideal or associated use, seizes them. These interests may soon *develop*. They often do. But at the moment of its 'bursting in,' there are no interests or developed feelings. To K. and S. it comes with a 'thrill of satisfaction,' and Wi. likes it as he would 'like a $10 bill handed him as a present.' D. says of 42, it 'somehow fixed itself into shape.' Again it is described as 'causing no jar.' Another division of this subclass is differentiated by the emphasis placed upon the suggestions arising out of the figure which is at first liked in and for itself. *E. g.*, one observer says, 'I stopped for this' and the next moment 'it looks like a memorial tablet.' He 'finds an interest' and this develops. In other cases, a 'general idea of the place where a favorable judgment is coming,' develops as the shutter moves. The suggestion as to the goal of the process, seems to come out of the

process itself. Again an observer refuses to go on because of an unpleasant figure, to which the process seems to be leading. The case of O. fearing to go to the narrow one which he said he preferred to the broad one given, probably belongs here. The middle ground between the broad and narrow contains some such suggested bugbear. H. once refused 60, which had been the previous jugment, but went to 39, because he did not know 'what it (60) was useful for.' For him, suggestiveness is a positive factor, and distinct from associations, *i. e.*, from preconceived ideals and uses. He demanded a certain development.

The square, or what the observer called a square, was frequently chosen. Some of these seem to be cases of the kind we are here dealing with. The observer explores the whole series and finds nothing that develops an interest or proves suggestive. He takes the square because nothing else is interesting. Not that *it* is positively interesting or suggestive; but in a series failing to produce a development, the observer makes choice of a figure which is least objectionable. This is preferable to no figure at all. He finds no goal in *form* itself, and so sets himself to the more formal task of making the sides equal. This is the only thing he can do. This may be in part the explanation of the rising curve in favor of the square in Fechner's results. (See table S. 195, *Vorschule der Aesthetik*.) Another motive for the selection of the square is present no doubt. The square may be the preconceived ideal. But observers often said, 'I like this because I don't like anything else.' This is given also for the narrower rectangles. *E. g.*, 'This is not bad, though I can't get what I want,' or, 'I like this (38.7) because all others are unsatisfactory.' Again an observer tires of a type, and takes something different merely for the sake of a change. H., working on the motive of calling card, made a 'good envelope.' O., getting tired of 30, which he had been giving quite regularly, gave some in 60 and some in 10 and 20. Such a motive often explains K.'s changes from the norm which stands out so clearly in his results. Sometimes the 'possibility of developing in two directions' is a determinant factor. *E. g.*, 'I like 87.3, because it is partly in the square


10
20
30
40
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L. Hor.
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3
4
L. Vert.
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2
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4
K. Vert.
1
2
3
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S. Vert.
1
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4

CHART 4.

series, and yet is not a square.' Again 45.3, is 'midway between the broad and narrow. Possibilities in these two directions bred the interest in this.'

3. In the last class of cases the suggestion grows. In contrast with it those to which we now turn, find the predominant motive in a preconceived idea. We may for convenience call these *associations*. We find a definite *expectation*, and the figure 'comes' to fit it. It is described as the '*developing* of a negative.' L. says 'I have always liked pictures and such things of this shape (54–62), *i. e.*, tall, high and narrow.' Another sees a window shade, and stops when it is the right distance up. D. says (60.5): 'This is what I have been trying for.' Sometimes these ideals cannot be realized. The observer is certain he knows what he wants, but he cannot find it. It eludes him. "I need something narrower, but I can't find it." Another says, 'I cannot get this (60) any time I want it.'

Among these preconceived notions which control choices are to be mentioned the things one knows about the golden section and its theoretical place in such work. The class embraces all notions of what ought to be the mathematical relations between the sides of a rectangle. *E. g.*, H. says: 'Mathematical associations as of the golden section assert themselves once in awhile.' This observer was giving, as a general thing, 28 and 90. This was also true of J. "General relation of golden section present." No other observer acknowledged this as a motive. Many of them had never heard of it. We made it a point to preserve their *naïveté*. Preconceived bad forms are also often determinative. D. says: 'I thought I was coming to something I would not like and so stopped.' In other cases it is said, 'to go on would be to destroy it.'

Associations are of course very numerous. A given form is good, because it is the shape of something which is familiar, or which one likes. Such objects as slabs, blocks of marble, step to entrance, coping over a doorway, sarcophagus, visiting cards, envelopes, photograph cards, window sills, entrance to a large house, open courtway, marble pillar, double door, church entrance with arch, bronze memorial tablets, transoms, window shades, loads of hay, and rising curtains, are found in the list.

These vary from individual to individual and with the same individual. H. was particularly fruitful in these. But all observers declare, many times, they have no associations.

4. The sensory elements indicated in this division are apparent chiefly in certain illusions. Three observers get illusions of movement. For W. (horizontal) ' with steady gaze, both sides seem to move out,' when in reality, only one moves. D. had a very lasting illusion of movement in the vertical series. He seemed persistently to desire figures of as much as ten centimeters width, but wanted more height than he could get. Of 78.2 he says, ' from here, the sides come in until I get the narrow one (47) and then the sides stand still.' Here there is an entire change of type, for, ' when he narrows still more the sides shoot out.' This in D. naturally leads to an illusion of form. He says, 35.2 " ought to get higher. But instead of doing this it gets broader." Of 55, he says, it needs to be higher and lower at the same instant. If he increases the height (vertical dimension) the sides come in, and if he decreases it the sides go out, and so, in both cases, his aim is defeated. Sometimes a whole series is given where this illusion does not operate. But usually some one or more in the four is affected. Where it is not operative, the wide figures, about 84–87, are given. The trouble with those wider than 49, under the illusion, is that the breadth leaves, or the horizontal lines are too short. Of 78, again he says, ' I like it when I take it turned 90°.' It is well supported. But moving along the horizontal line, as it is, it is flat. Again, 60 is good so long as he keeps his ' attention off the horizontal lines, and so resists the tendency to narrow it.' Control of attention can defeat the illusion. 17 is the first place in closing where he could ' defeat the horizontal cramp.' This illusory transfer of movement may be responsible for the greater spreading of D.'s results in the vertical series.

Another observer gets an illusion of the white card moving to meet the black, whereas in reality, it moves with it. Another sees the white as ' uncrumpling ' or moving out both ways with the ' new substance welling up in the middle,' as the figure opens; and for him the white seems to be ' crushed in ' as the figure closes. As to the form, again, the vertical lines are often

seen converging toward the top, in the horizontal movement. The corners are too large; the advancing line is 'jagged' or 'bulged,' or 'wavy.' In his first work (horizontal 'moving in') D. says of 61, 'It is jagged up to this point; 61 assumes definite appearance; and smaller than this, is amorphous.' Another likes the figure whose sides are broken and not exactly at right angles to each other.

Another wants less light, 'to remove harshness of outline.' One says, 'the narrow ones get into a shadow,' when there is no objective shadow. Wi. says 64 is 'soft and restful to his eyes.' 'The glare of 95,' he said, 'was what made the sides slope in at the top.' He complains of 40 that 'it is a little dark, the corners do not show up well, and has to move to get it clear,' though no complaint of darkness was made about 28, immediately afterward, when 28 was preferred to 40. D. often wants something bigger than he can get. Of 44.2, 'I want something the size of the square and the proportion of this,' and of 49, 'I suppose this is what I would like if I could see it large.' These illusions and demands are all in a measure criticisms on the method, but more particularly are they cited here to be reckoned with in explanation of the results.

5. The motor element, it is true, was brought in by the experimenter in every case when considered. That is he carefully questioned the observers after considerable work had been done, as to the presence, especially of eye movements. Some follow the moving edge of the black card, but they find this does not give them a satisfactory view of the changing figure. Sometimes, they move the eyes alternately, first in one direction, and then in the other. Wa. says she probably knows when she has the right figure, by eye movement. D. says of 74.7, 'There is a balance of the two movements of the eyes.' There is a pain in the eye for further lateral movement. 'But the square (100) just before it,' is not explored by eye movements. "And 29.5, (horizontal) is explored up and down, only. The narrow top is easily measured without movement." He is very certain that the feeling, 'the figure is the right one,' does not come as a development of kinesthetic sensations from the eyes. All observers agree, that they really size up a figure with a fixed

gaze, taking in the whole. K. says, 'when you get a satisfactory one the eyes are still.' As one gets used to the apparatus, he invariably drops exploration, finding the best results come with steady gaze.

Of course, there is an important motor element in that the observer makes the figure for himself by pulling on the cords. One likes the narrow figures, 'because they are easy,' requiring only a little movement. Another likes it, because 'I know I am making it.' And wherever the observer has a ready-formed purpose, this gets fulfilled by his own production, if the quest does not prove futile, by reason of limitation of opportunity or otherwise. His *doing* is an important factor in the resultant satisfaction. By the balanced control of the pulls executed, through the two hands, he has made that which fits his purpose. It is his own, and he likes it. Some observers say, 'I like that now, since I made it or found it myself. I do not know that I should, if you had showed it to me.'

IV.

In the face of such a great variety of motives as above described, can we hope to find a single principle of explanation of the species of phenomena under consideration? There are very manifest differences in kind of motive. In fact, we find in this single study as great variety of motives, as there are theories occupying the field. In view of this variety, it is hardly to be expected that any one of the current theories can be adequate to a complete explanation of these æsthetic phenomena. Associations, for example, are clearly inadequate to explain the reactions of many of our observers. One observer never had associations with the figures she liked. Only when asked why she did not like the figures that were repulsive to her, did she find associations. She could never give a reason for liking the figure, except such as were descriptive of the figure itself. No more can motor sensations be made the basis of a complete explanation of æsthetic reactions. They are no doubt a factor, but we find they are only one, and comparatively unimportant.

In fact, Stratton (*Philosophiche Studien*, XX.), has shown very conclusively, that eye movements made in exploring a

pleasing figure, of either right or curved lines, do not follow the graceful and easy lines of the figure. The movement is jerky, and is interrupted by frequent stops. This, of course, does not preclude obtaining a fairly accurate measure of the two dimensions of the figure, by the eyes; but it does warn us not to rest too much upon the kinæsthetic sensations from the eyes in the explanation of our choice of rectangles. The play of motor elements which are not actually functioning, is of course important. The figure is sized up by 'staring at it' say some observers. Of course, given retinal stimulations, may mean for the observer, certain definite movements. The local signs are fused, by means of the suggested movement, into space perception. The perception, as in all cases, grows only by the integration of motor with sensory elements, even though these motor elements are only latent movements.

There is though, more importance attaching to the sensory side of the process, so-called, than is sometimes allowed. In such an experiment as our own, the simultaneous stimulations of parts of the retina with light of greater intensity, brings out the figure independent of eye-movement sensations. Having given the adaptation of the eye to the dark screen, in our experiment, what happens when the shutter is drawn open? Clearly there is a relation between the required adaptation to the brighter surface now exposed, and the existing adaptation of the dark surface, which must prove a determining factor in the size of the chosen figure. The greater illumination in the centers of the retinæ, not only calls for an adaptation in these areas, but also to a new adaptation or a readjustment in the surrounding portions whose absolute stimulation has not changed. In other words, McDougall's [1] explanation of simultaneous contrast applies here, in part. This double process of readjustment, and the relations between the two processes, explain many of the illusions of form, such as jagged lines, sloping lines, and large angles. It may also explain many of the demands for size, as well as the expressions, 'it is soft,' 'comfortable,' and 'easy on the eyes.' There is of course, a motor element in these so-called sensory processes. Retinal adaptation clearly has a motor side. Mc-

[1] *Brain*, 1903, Pt. II., pp. 183 ff. See also *Mind*, N. S., XII., pp. 473–488.

Dougall shows that the after-image depends upon accommodation. And adaptation, doubtless, depends upon some motor processes. But for any definite statement of what it is, we are awaiting the future results of histological physiology.

Other motor sensations than those of ocular origin, no doubt play an important rôle. We have already mentioned the arm movements. One observer was very conscious of these. He often put his forefingers out on the cords and thus controlled the movements of the shutter through the more accurate articular sensations from the fingers. These sensations are a basis of choice, in an observer who says, 'I like that because I can make it easily.' But much more are they the means of doing what one wants done,— they are the media for the realization of our purposes. And this calls attention to a transition similar to that made above. As the eye movement may be the basis of the perception of dimensions, and so of the preferable figure, *and yet not become a movement*, so our motor tendencies as a whole, may be the basis of our choice of a rectangle, although these lie wholly dormant. This is the basis of many of our choises which show no definite motor factor. The motor side of these æsthetic processes, is highly important for the purposes of explanation, because it is so important a part of the process.

Another explanation of æsthetic judgments closely akin to that of balance of eye-muscle sensation, is that which endeavors to explain our likings by what may be called a balance between attention forces. It may be stated objectively as a balance of attention-drawing features in the object. They are sometimes spoken of as *forces* in the picture or the line. But they are forces of attention, so that it is ultimately and fundamentally a balance of attention and interest, which is made the basis of explanation. Thus, in the case of our rectangles, it would be said, that a given width is coördinated with 100 mm. of height, and a given height with 100 mm. of width, because this width or height has an interest or attention-drawing power equal to the interest in the 100 mm. height or breadth, respectively. This theory is valuable, in so far as it is an explanation of the wide departures from the golden section. One's interests change. The observer views the shorter (or the variable)

dimension, in different lights at different times. It has now more of his attention, and now less, owing to the different ruling interests. So its affinities are different. Hence also the varying results, from observer to observer, as well as in the same observer from time to time. Our objection to this theory is, that it is not an explanation of the complex phenomena under investigation. It is very aptly descriptive of the facts in broad outline, but it leaves us with the problem of explanation, where we start. It seems on the face of it to go back to very simple elements. But attention is both the most baffling, and the most complex of psychological concepts. We cannot hold, therefore, that a theory is final which bases on attention, and says the asymmetrical elements are harmonious because of a psychical balance brought about by more attention or interest to the shorter. Any balance brought about by a heightening of the vividness of one element through attention, can by no possible means be ultimately simple; for this heightening is itself a complex process, not mere addition. It is a typical piece of organic mental growth. This being granted, it is the first business of the student of the phenonenon to gain insight into the mechanism of this growth. And when he has seen the component part processes of each, he will be in a position to understand the æsthetic balance between two given whole processes. What we have called *suggestiveness*, helps us, in some measure, to the desired insight.

In our experiment, under normal conditions, the observer was not consciously concerned with a balance. It was primarily a question of satisfactoriness of form. To be sure the form used is, to the analytic onlooker, only a composition of the two dimensions. To consider the relations of these two lines, each to the other, would be, *a priori*, a simple problem. But our experience confirms us in the view that this form may be considered — in fact is naturally considered — independent of, and prior to, the relation between any two contiguous sides. This is, in fact, a very primitive æsthetic experience, and insight into the reactions of the class called suggestive, really affords a basis for the explanation of the so-called balances of attention. For it does not require there should be two new ex-

periences in order that we should have an æsthetic reaction — a balance between them. At least the restriction of the term, æsthetic, to such limit, precludes the cases, which alone, as it seems to us, give insight into the mechanism of the higher æsthetic emotions.

In the cases called suggestive reaction, the experience comes to a mind alert, but inactive,—attentive, but without any purpose, save to get the experience that comes from the presented stimulus, and to note the pleasantness or unpleasantness of this experience. In some of these cases, the experience seems very immediately pleasant. As contrasted with what we have called purely æsthetic, there is a reason here for the pleasantness, in the suggested *use* of the form. And they are different from cases of association, too, in that the use is suggested by, and comes out of, the experience itself. The emotional reaction and the suggested use seem to come simultaneously. On this point it is difficult to obtain definiteness by introspection. But *a priori* we would suppose that the suggested use preceeds and that the pleasantness is an indication of the mutual appropriateness of the experience and of the use, each to the other. This *a priori* view is supported by introspective evidence from another class of *suggestive* cases.

In these, as the observer changes the figure, a purpose arises which is not fulfilled. A goal is set for the process, as the process itself is perceived, member by member. By the use of this word goal, we do not wish to denote an end for action, consciously present in the observer's mind. It is rather the conative process set up by the sensory processes serially perceived. This conative process is too large and too vague for immediate execution, but it is that which determines the motor outgo of the moment. There thus arises or exists a disparity in the mind. Our clearest way of expressing this, is, that it is a disparity between the goal for which the motor outgo starts, and that which it realizes. It is, in fact, though, to the observer himself, at the moment, simply a baffled emotional state. The aroused emotional tendencies fail to get realized. The balance here is between the ideal, however vague, which always means conation, and the incoming experience.

The æsthetic moment is the moment of satisfied wants. In so far as there is satisfaction with the new experience, there is no further conative tendency. This is the case, in part, with what we have called purely æsthetic reactions. It is characteristic of the æsthetic mood. But right here in the sensi-motor circle[1] of the mental processes, at the point of impact of the sensory processes, is the place where emotional tendencies or ideals arise. The incoming experience either satisfies or it does not satisfy the previous emotional tendency or conative impulse, and in so far as it jars on it or fails to fit in with it, a new emotional tendency arises, which, expressed in terms of intellectualist theory, is an ideal. This in turn, leads to a new motor outgo, which brings a fresh sensory process, and so the circle repeats itself over and over; but it is mounting as a spiral, and growth is occurring, through the organization of this men-

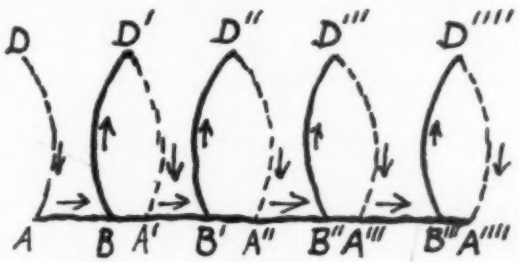

FIG. 3.

tal material called emotional tendencies. And the mechanism of this growth is through the impulses imparted by the incoming material jarring on the emotional incentive which led to the motor outgo. And right at the point of impact of the sensory income, as said before, is the place of the æsthetic feelings. These are simply the satisfactions with what we have called the *fit* of the *incoming* with the *emotional incentive* to the outgo, as the unpleasant are the dissatisfactions with the misfits. Thus we see the very fundamental place of these feelings in the growth of the mind. Our meaning may be brought out better by a diagram. Let A, A', etc. (in Fig. 3), represent successive sensory processes just arising through the action of stimuli

[1] We refer to the circular process in mental life so admirably developed in Professor J. M. Baldwin's *Mental Development in the Child and the Race.*

coming from objects D, D', etc. The psychic stream is represented by the line A–A'''', and B, B', etc., are incipient motor outgoes. A–A', etc., are then places in the circular reaction where the fit or the misfit of the new experience arises, this being the feeling of satisfaction or dissatisfaction. In the case of the latter, an emotional tendency to action organizes from this point and emerges in action at B. The return sensory process is at A', and this leads to a new motor outgo, B'. So the organization proceeds. This is simply to illustrate the place as we conceive it, of the elementary likes and dislikes in the sensi-motor circle before there is other psychic life.

Association and suggestion are such important elements in our theory, and they are so likely to be confused, that some added remarks are introduced at this point on their relation to one another. To start with the characteristic difference from the descriptive point of view, we may say that suggestion carries with it the specification of a definite use for a given figure, while association always affirms the likeness of a particular figure to a class or group of figures. Put into general terms, this means that suggestion is characteristically practical while association is theoretical or scientific, so far as motive is concerned. This has direct bearing upon the material and relative simplicity of the two classes. As to material, we may say that suggestion is predominantly emotive, but association intellective. That is to say, the wants that are contemplated by each class are different. Association seeks for a definite relation between the given object and the observing subject, in which case the æsthetic mood is held in abeyance, and is made to depend upon the solution of a problem. For illustration of this we refer to many cases where the square was chosen (see page 368). Suggestion subordinates the relation between observer and the thing observed, and allows free play for the feelings in determining the æsthetic object. In this way, the ideal is found, not made. It is discovercd, not anticipated. Thus we may see that suggestion is relatively much more simple than association. It takes us back nearer to the *elements* of the æsthetic experience.

This may be made clearer by laying bare the processes involved in suggestion and association. It is a commonplace of

psychology to-day, that all psychic material is dynamogenic. When we are at the roots of mental life, this means that the question, 'What are you going to do?' is much more fundamental than, 'What do you perceive?' So that whether we perceive anything or not, the primary arousements of consciousness involve us in some kind or other of activity. It is not possible, on the basis of the present study, to go beyond this fact of motor connection. It is however, the point which is most

FIG. 4.

emphatically borne out by the results which we have presented above. This connection is the simplest form of psychic process with which we are acquainted. *What* the connection is and *where* it is, we are not able to say. These remoter questions are extremely interesting, but beyond our present work. All we can now affirm is, that impressions coming from the object *D* reach consciousness at the point *A*, and go out in motor discharge toward the object from the point *B* (see Fig. 4).

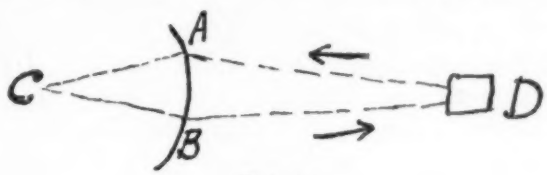

FIG. 5.

The importance of the motor reaction consists in its making secure the connection between *A* and *B*, and probably, in giving greater definiteness to *A* directly. In contrast with this, association is a more complicated process. Instead of defining *A* through *B* we have here the interpretative idea *C* (see Fig. 5), which is a go-between for *A* and *B*. The definiteness that comes to *A* from the motor outgo *B* in this case comes through *C*. *C* is also a factor determinative of the motor reac-

tion. That is to say, action is probably both ways in this complex arc, as it is in the simpler one above.

Two other points of relation between association and suggestion should be mentioned in passing. One is the difference in the ways of their inception. The suggestive process starts at *A* of the above figure and the associative process starts with *C*. In the former, there is nothing until the sense experience suggests it, and this runs simply to its own fulfilment in the simplest cases, as a sort of psychological reflex. In the typical associative process, however, the preconceived idea *C* is the starting point and controlling factor of the whole. The other point of difference is already evident. The associative process is the more general of the two. This is consequent upon the complexity mentioned above. Suggestion leaves you with the particularity that belongs to the individual object or form — it makes it more concrete than at first; association takes away the individuality and substitutes the universality of the class. Association is essentially a process of classification, and this implies emphasizing common features. This is what was meant by saying that association comes from a scientific motive; it is fundamentally the process of classifying experience.

These suggestive and associative processes are not always pure and clearly distinguishable. The suggestive, being the more primitive, is always involved in the associative. There are also many gradations between the two. The suggestive process is often the starting point of an association. The process starts as a suggestion, but the psychic processes develop so far and so explicitly in advance of their realization that the idea, or ideal use, of this kind of experience serves at once as a guide to the motor outgo. Comparisons are prominent, and the whole has been raised into the higher psychic plane. Whereas, had the case remained simple we should have had a development without conscious guidance, on the level of simple feeling and mere conation. It is in rare instances, and usually under experimental conditions, that the human subject can know that he has had such an experience. As another example of mingled suggestion and association we mention those cases where an association helps on a suggestive process, but leaves it free to be

controlled by the objective interests. You may have a limit imposed, as when you want a full length Madonna painted. The size is a definite, associated restriction upon the process, imposed by our ideas of use. But in many ways suggestion works unhampered.

We thus get a glimpse of the way in which that which is not perceptive or intellectual psychic material develops into that which is intellectual. It consists in seeing how that which we have called emotional tendency (*A–B* in Fig. 4) becomes ideal or interpretative idea (*C* or *A–C–B* in Fig. 5). The animal that can feel an incrongruity and stay by it, adjusting itself to its environment on the one hand, and adjusting the environment to itself on the other, is the animal that will survive; and the fittest to survive, has most of this accomodative power. Analytic power, which is the precursor of synthesis or generalization, which in turn is association, emerges at first very crudely in a being able to react on an aspect of an experience, neglecting unessential details. This kind of analysis at once has great survival value, and the animal that can translate his various impressions into an ordered experience will have begun the ascent of mental as distinguished from organic evolution. Thoughts are feelings objectified on the basis of wants through motor response to existing environment. Feelings and conation are directly connected, and when feeling becomes *generic*, *i. e.*, tends to react in response to the object for less than the object actually is, it is making possible that definite implication of the object in consciousness, which is the characteristic of intellectual life.[1]

[1] The MSS. of this article was received on March 17, 1904.—ED.

CONCEPTIONS AND MISCONCEPTIONS OF CONSCIOUSNESS.[1]

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Were the use of the term consciousness to be forbidden for a season, contemporary thought would be set the wholesome task of discovering more definite terms with which to replace it, and a very considerable amount of convenient mystery would be dissipated. There is no philosophical term at once so popular and so devoid of standard meaning. How can a term mean anything when it is employed to connote anything and everything, including its own negation? One hears of the object of consciousness and the subject of consciousness, and the union of the two in self-consciousness; of the private consciousness, the social consciousness, and the transcendental consciousness; the inner and the outer, the higher and the lower, the temporal and the eternal consciousness; the activity and the state of consciousness. Then there is consciousness-stuff, and unconscious consciousness, called respectively mind-stuff for short, and unconscious psychical states or subconsciousness to avoid a verbal contradiction. This list is not complete, but sufficiently amazing. Consciousness comprises everything that is, and indefinitely much more. It is small wonder that the definition of it is little attempted. One of the most successful efforts is that of Professor Ladd, who regards consciousness as the difference (presumably from the sleeper's point of view) between waking and dreamless sleep. This is equivalent to the difference between more or less of something, and nothing at all; which is quite accurately true to current usage. Baldwin's *Dictionary of Philosophy* defines consciousness, on the one hand, as 'the distinctive character of whatever may be called mental life,' and mind, on the other hand, as 'the indi-

[1] Read before the American Philosophical Association, December 30, 1903.

vidual's conscious process, together with the dispositions and predispositions which condition it.' But it is more customary to say frankly that the term is indefinable. If it were taken for granted that it is therefore better left unemployed in exact thinking, there would be no occasion for objection. But its indefinability is more commonly attributed to the profoundness of its meaning. Indeed the definition of being in terms of consciousness is set down as the surviving and most illuminating truth of philosophy. The hope is expressed that we may now postulate it and proceed to more debatable matters.[1] And consciousness so regarded as the fundamental ontological truth, is called upon to carry and protect man's moral and religious interests. Especially in the nineteenth century has this term suffered the taint of eulogy, through being made the watch-word of non-materialism. The advocates of the spiritual man, never over-scrupulous in their choice of weapons, have in this case been willing to confound the enemy by confusing him. 'What are you going to do with consciousness?' asks the idealist. The materialist, not knowing precisely what it is, but convinced that it bears no resemblance to a motion or a secretion, does nothing with it. Whereupon the idealist shows him what he can do with matter, and the materialist, who is a stupid adversary at best, takes refuge in a general protest against metaphysics. The defeat of materialism is not to be regretted, but there must be no uncritical acceptance of the victor. The term consciousness as at present employed is too reminiscent of this controversy. It stands for a general propaganda, which runs some-

[1] "There are certain accepted doctrines of modern philosophy — *e. g.*, that knowledge is only of phenomena, not of anything unrelated to consciousness, and that object and subject are correlative — from which this conclusion seems to follow so inevitably, that anyone who has adopted it must enquire anxiously why it is not more generally recognised. If nothing can enter into knowledge that is unrelated to consciousness; if relation to a subject is necessary to make an object, so that an object which no consciousness presented to itself would not be an object at all; it is as difficult to see how the principle of unity, through which phenomena become the connected system called the world of experience, can be found elsewhere than in consciousness, as it is to see how the consciousness exercising such a function can be a part of the world which it thus at least coöperates in making." Green's *Prolegomena to Ethics*, pp. 14, 15. Compare the more recent statements of C. A. Strong, in *Why the Mind has a Body*, pp. 166, 183, 186. The criticism of such views as these is undertaken later in the present article.

what as follows: psychology and transcendental logic disprove materialism, seat God on his throne, and prove the immortality of the soul. When one ceases to look upon them from the standpoint of the counter-thesis of materialism, these are impossible allies. Consciousness cannot mean everything and yet mean anything. As a name for the psychological aspect of experience, it may be shown to mean something definite and important; but consciousness so interpreted is confused and misconceived when called upon to serve as a metaphysical account of being, and is no safeguard of man's spiritual interests. Consideration of morality and religion will be omitted from the present discussion, which will attempt first to account for and define a concept of consciousness, and second to criticise its metaphysical use.

Only a successful analysis can justify the proposal to account for this concept in terms of psychological experiences, the more so since the term 'psychological' must be defined at the same time. But the arbitrariness of the procedure is at a minimum when we begin where the race and the individual have presumably begun to learn of these matters. Before a certain moment in the development of reflection the self is theoretically indistinguishable from body, and conceptions of it throw no light on the idea of consciousness; while after that moment the self is conceived with definite reference to a specific type of experience which has come to be noted and differentiated. That which makes this difference between the early cosmological, and the later radical or critical conceptions of the self, is the distinct employment of a set of ideas signifying seeming or appearance. While primitive experience is entirely free from any general idea of the dependence of objects upon the knowing of them, there are certain accepted cases in which an experience is definitely recognized as *my experience*, or certain facts which are regarded as deriving existence from a *for-me* relation. This is a very different idea from that of the functioning of the sense-organs. That I see and hear and taste is a commonplace of all experience, and I may study what I see, or the manner of my seeing, without effecting any discontinuity in my practical or scientific world of things. But to believe that what I

see is constituted by my seeing of it, is to define a new realm, an anomalous science, and possibly a new philosophical method. Such a belief must arise very early in connection with discredited or illusory experiences. Illusions so vivid as dreams are doubtless in the beginning often regarded as unusually significant experiences of objects, but such can scarcely be the case with all dreams, with fever-deliriums, and with wanderings and inventings of the imagination. And these adventures are homogeneous with certain very familiar and normal happenings. Experience is constantly correcting itself and discrediting its earlier content. Observation and identification is a process of self-correction. The surviving judgment is the last of a series of discarded judgments which were once as living as itself. They are not the object *A*, but 'what I thought,' 'the way it seemed to me then,' my mistake, or confusion. To be sure, such retrospect is not demanded for the direct purpose of observation or identification, but they cannot altogether escape the notice even of the man of affairs. They tend, as in the case of the double images, to be neglected because not important. They become important, however, whenever the task of thinking becomes specialized, and interest is aroused in conditions that tend to determine its success or failure. Error and confusion come then to be attended to, and designated as a realm of idiosyncracy, to be corrected or repudiated by the wise man. The appearance of these ideas in early Greek philosophy is familiar history. They determine the common distinction between 'truth' and 'opinion'; and the Protagorean doctrine is an inference from them.[1] The aspect of experience recog-

[1] A special interest attaches to the earliest statements of this idea in philosophy. The following are representative:

"It is not meet to act and speak like men asleep." "The waking have one and the same world, but the sleeping turn aside each into a world of his own." *Heraclitus*, Fragments 94 and 95 in Burnet's *Early Greek Philosophers*.

"Welcome, noble youth, that comest to my abode on the car that bears thee tended by immortal charioteers. It is no ill chance, but justice and right that has sent thee forth to travel on this way. Far, indeed, does it lie from the beaten track of men! Meet it is thou shouldst learn all things, as well the unshaken heart of persuasive truth, as the opinions of mortals in which is no true belief at all. Yet none the less shalt thou learn of these things also, since thou must judge approvedly of the things that seem to men as thou goest through all things in thy journey." *Parmenides*, in Burnet, *op. cit.*, p. 184.

nized in this old epistemological criticism has played an important part in modern philosophy, where it appears notably in Spinoza's conception of modality and inadequate ideas, in Kant's manifold of the internal sense, and in Hegel's doctrine of subjective spirit. It furnishes the most likely definition of the field of psychology, and with reference to its bearing upon this problem, let us consider the analysis independently of its history.

The first intent or bearing of experience is objective,[1] as expressed in the judgment, *that is A*. But experience proves to be self-corrective. The content of *A* grows in the direction of its own completeness. *A* is in the first instance more or less problematical, and increases in articulateness. While the direction or interest remains the same, this experience is homogeneous, an experience, we say, *of the same thing, or context of things*. But an act of attention is possible whereby the direction is reversed. With this new interest there now appears a series of corrected experiences, to any degree of inadequacy. These specific limitations may be noted and attributed to specific conditions. In this wise the corrected and replaced experience, in contradiction to the corrective experience, is viewed as merely *my experience*, a term of my blindness and struggle. Since I have now apprehended the thing itself, I can define my more or less successful purpose with reference to the thing. In ordinary experience I have my face to reality and my back to such of the

"And the soul is like the eye: when resting upon that on which truth and being shine, the sou perceives and understands, and is radiant with intelligence; but when turned towards the twilight of becoming and perishing, then she has opinion only, and goes blinking about, and is first of one opinion and then another, and seems to have no intelligence." *Plato*, Republic 508 D, Jowett's translation. Cf. 510, 511.

"The senses are variously named hearing, seeing, smelling; there is the sense of heat, cold, pleasure, pain, desire, fear, and many more which are named, as well as innumerable others which have no name; with each of them there is born an object of sense,—all sorts of colours born with all sorts of sight and sounds in like manner with hearing, and other objects with the other senses." From *Plato's* exposition of *Protagoras* in Theaetetus 156 B, Jowett's translation. Cf. 157.

[1] I am at pains in this part of the analysis to avoid any verbal suggestion of the indispensableness of the subject-object relation. I shall, therefore, so far as possible, use the terms 'thing' and 'real' rather than the equivocal term 'object.'

cognitive process as I have passed by. But I may turn and behold the way I have come, together with its stages; and these latter I now denominate *points of view* in contradiction to that which may be so viewed. Such is the psychical fact and the reflection required for the identification of it. Let us turn to the consideration of examples.

The most unequivocal instance is the dream. This is a definite type of invalid experience, recognized as such from the standpoint of a valid corrective experience. Were there only dreaming, there would be no dreaming. Either I must myself awake or have my illusions observed by another, who both knows them and knows beyond them. The waking and the dreaming differ in that the former not only succeeds the latter, but includes and replaces it; while the latter on the other hand knows nothing of the former. The waking experience defines my dreaming, and in the presence of the real judges it to be unreal. When I wake up to the actual situation, my dreaming takes on the duller hues of a subjectivity and fancy which I significantly call my own.

There is a similar distinction between the narratives of the historian and the eye-witness. The historian corrects the experiences of the eye-witness by marshalling contemporaneous events and by eliminating the more accidental sequences and coincidences of observation. In view of the real order of events, the uncritical report of an individual may be circumscribed and identified as such. A continuous series of maps of the battle-ground, with the formations and movements of the combatants, would so include and transcend the order of occurrence in the experience of a soldier of the ranks.

Let us turn to those instances that are due to the deliberate psychological interest. The need both of an included and of a supervening experience is here determinative of a method, and is most clearly in evidence in the case of comparative and experimental research. The experience of the animal, child, savage, or abnormal subject, is viewed as within a valid world of experience, and interpreted in terms of specific and characteristic limiting conditions. In experiment these limiting conditions are in part artificially provided, and with them is

coördinated the report of the subject, the whole being contained in the presumably or practically unlimited experience of the investigator.

But lastly let us consider the more crucial case of introspection, and in particular, introspective attention to perception. How is the psychological manifold differentiated from the thing-manifold where there are no social relations involved? The possibility of it is clear, the manner of it obscure. I can analyze my perceiving on the one hand and the object of my perceiving on the other with quite different results, and yet in the perception they are indistinguishable. The difference must lie in my interest, or in the direction of my attention, and it appears here also that one interest is fundamentally determinative. Indeed, the method is essentially identical with the judgment, 'I have been dreaming,' except that in this case the invalidity of the corrected experience is less radical. Introspection is retrospective attention to an experience which I now surround and surmount. That more or less complete apprehension which can now become a distinct manifold for me because I compare it with the occasion itself, I call *my state*. The actual method employed in this type of investigation is commonly hidden on account of the rapid alternation of interests. My objective experience is constantly awaking from new dreams. I must oscillate rapidly between the standpoints of experimenter and subject. From my standpoint as experimenter, my experience as subject is the relatively inadequate experience whose boundaries I may now view retrospectively and whose limiting conditions I endeavor to analyze. Consider the case of my perception of a house, which tends to reveal to me its true geometrical form, together with the totality of its exterior and interior. In ordinary experience I have it so present to me; practically, as is attested by my dealings with it, and theoretically, as is attested by my description of it to another. But I may compare with this valid experience the inadequacies which are contained and compensated for within it. My corrected spatial perspective would constitute such an inadequacy, and I may analyze this as respects its content, and as respects the manner and the means wherewith the correction is made. In such procedure the house has

been regarded as the culminating event in a process of mind, and the factors determined by such an analysis are called states of mind. This interpretation of the method of introspection might be further and more readily illustrated with reference to imagination and memory. The same method holds in the case of feeling, this psychical factor appearing in the experience, *I want or like A*, in contradistinction to the experience, *A is good*. Feeling is an invalid judgment of worth. In each case the field of psychology comes into view only when an incomplete experience is recognized as such from the standpoint of an experience regarded as objective. The corrected or discredited experience so determined critically in an experience of things, is regarded as merely my experience, and may be analyzed as such. But we must have passed beyond the psychical to become aware of it. These psychical data cannot be called things or reals in the same sense as the standard objects, for they are completed and replaced by the latter. We therefore provide a radically different category for them, and recognize that their content is common to themselves and to things, while their specific character is given them by their limitations and context.

Accepting for the present this definition of consciousness in terms of relativity, let us examine the attempt to construe it as a philosophy. Such a theory might properly be designated as psychological idealism, and is known under the names of perceptual idealism, phenomenalism and sensationalism. This theory arises from the thought of the possibility of indefinitely extending the psychological manifold. Every corrective experience may, and tends to become in turn, a corrected experience. There is no experience of which one may not come to say, 'it is my state,' or, 'it is your state.' "At first sight," says Walter Pater, who styles himself a new Cyrenaic, "experience seems to bury us under a flood of external objects, pressing upon us with a sharp and importunate reality, calling us out of ourselves in a thousand forms of action. But when reflexion begins to act upon these objects they are dissipated under its influence; the cohesive force seems suspended like a trick of magic; each object is loosed into a group of impressions—colours, odour, tex-

ture—in the mind of the observer. * * * Experience, already reduced to a swarm of impressions, is ringed round for each one of us by that thick wall of personality through which no real voice has ever pierced on its way to us, or from us to that which we can only conjecture to be without. Every one of these impressions is the impression of the individual in his isolation, each mind keeping as a solitary prisoner its own dream of a world."[1] On such grounds one reaches the generalization that every knowable object is someone's perception, or the more radical persuasion that every knowable object is his own perception. The only definable being is seeming. In terms of the above analysis, this is equivalent to the proposition that everything so far as knowledge is concerned is invalid experience. To assert this proposition is, of course, to plead scepticism. But even as scepticism it is not tenable, since it is a criticism of experience according to a principle. There can be no experience of a world in which each mind keeps 'as a solitary prisoner its own dream of a world.' The Protagorean mind must itself have awakened and broken from its prison. Madame Ackermann is quoted as saying: "My last word will be: 'I have been dreaming.'"[2] But in that moment she will at last have ceased to dream. Relativism will not do as a doctrine, though it may serve as an apology for silence. And where the Protagorean principle has been asserted, it has almost invariably been associated with a deeper metaphysics calculated to make this principle itself a psychological one. In the case of Protagoras himself, the world was conceived with Heraclitus and Democritus as essentially motion. Perception is itself a type of motion, and so incapable of fixing upon permanent being. But motion itself is otherwise and distinctly conceived, so that perception is defined in terms of being, and as *within* a world. Such is clearly the case with all definitions of the perceptual realm in terms of so-called 'secondary qualities.' Where the motive of the physical sciences is the determining one, and this is very commonly the case, the world gets itself divided into the physical and the psychological realms, the former being

[1] *The Renaissance*, pp. 247–248.
[2] James, *Varieties of Religious Experience*, p. 63.

employed as the standard and defining world. And here a subsequent reduction of knowledge to psychological terms is evidently contradictory.

The perceptual idealism of Berkeley announces subjectivity as an ontological, and not merely an epistemological principle. The famous dictum, 'esse est percipi,' is the ontological counterpart of the more ancient dictum, '*Πάντων χρημάτων μέτρον ἄνθρωπος.*' But it appears shortly that to be is rather to perceive, or to cause to perceive. The soul and God are the real terms of the perceptual relation, and they are themselves revealed in another order of cognition. Berkeley's later tendency to abandon his perceptual idealism for one of the Platonic type is well-known, and emphasizes his inability to make an objective order out of the psychological realm. But he persisted in this course so far that he made content and subjectivity coextensive, and was then under the necessity of adding the objectivity all at once and abstractly. The same necessity is interestingly exhibited in the case of J. S. Mill, whose category of 'possible experience' functions similarly as objectivity conceptually and artificially superadded to a content that has been stripped of it.

Sensationalism in its other modern and contemporary phases scarcely warrants serious treatment. It commonly defines sensations as events within a physical world, and then gravely announces that these sensations, as the simplest terms of introspective analysis, are the ultimate beings. But the perfection of this contradiction is enlightening. The sensation is the quintessence of relativity. It signifies objectivity at a minimum and subjectivity at a maximum. Simple pressure, or the lonely and unrecognized sound, are the first dawning or the last waning of objects. But they are such vanishing points only in the light of their all but entire inadequacy. In themselves these pulses of experience are objective, and are remarkable only when we come to consider the great degree of their deficiency. Sensationalism means the attempt to define being in terms of what it is not. Indeed, such a plan is virtually announced in the language of all relativists. The Protagorean proposition stated ontologically would read: all things are the human measure of them, which contains the same substitution of a

passive for an active or neuter verb that is remarkable in the Berkeleyan principle. But any account of being in terms of another than itself is as unprofitable as it is contradictory.

The *transcendental idealist* would doubtless regard the discussion up to this point as a stage in the development of his own argument, and he must now be reckoned with quite independently. His doctrine is established with direct critical reference to psychological idealism. The impossibility of defining objects in terms of relativity is allowed to conduct the thinker dialectically to the conception of the absolute. The sequel to my error or exclusiveness, is truth or inclusiveness. The outcome of this dialectic is determined by the symmetry of the antithesis. Corrected experience implies a last correcting experience; partial cognition, complete cognition; empirical subject, a transcendental subject; finite mind, an absolute mind. Hence being is definable as for a standard, complete, transcendental or absolute consciousness. Now it is evident that the validity of this reasoning depends upon the degree to which the limiting adjective determines the meaning of the substantive. If consciousness means limitation, then absolute consciousness is a phrase but not an idea. Where consciousness is recognized as relative, what does it mean apart from that relativity? This question has remained unanswered so far as transcendentalism is concerned. But if consciousness known as experience relative to a point of view, is not defined save in terms of that circumscription, then to retain the concept of consciousness for a realm defined as free from just that factor of circumscription, is sheer absurdity.

Let us consider briefly the Kantian foundation of transcendentalism. The *Critique of Pure Reason* taken as a whole, informs us that the object, so far at any rate as knowable, can be neither inside nor outside of my private consciousness. The dilemma is solved by defining the object as apperceived by a transcendental ego which is the ideal cognitive subject logically immanent in my consciousness. This subject remains for Kant a law of my consciousness and thus dwells in that logical realm which is neither soul nor nature, until it enters into the real world under the form of faith. But its

relation to the realm of knowledge is such as to define nature as phenomenal on the ground that it falls between the unthought world on the one hand, and the completely thought world on the other; between the residual objectivity of the perceptual experience, and the ideal objectivity of the conceptual experience. There is too much or not enough of consciousness in the natural world to permit of its being a world of things; too much because space and time are merely subjective necessities, and too little because these forms of perception are such as prevent the realization of the ideal of subjectivity itself. The phenomenal realm is distinguished from such a realm as would have its being independently of thought, and such a realm as would have its being in the perfection of thought. So far as theory is in question Kant leaves us here. For the post-Kantian who wishes to define a metaphysical doctrine, there are two possibilities. He may conceive that successful thought ceases to be distinguishable as thought, and therefore realizes being as independent of thought; or he may conceive that successful thought is still essentially thought and therefore realizes only its own consummation. Kant's phrase 'intelligible intuition' permits either interpretation; the former is the way of realism of the Platonic type, the latter the way of post-Kantian idealism. But the only account of mind that is offered even by the idealist is an account in terms of its practical function with reference to the things which it seeks to evisage. As in Kant's delimitation of the realm of the internal sense as psychological, the realm of physical or external experience becomes for the moment a realm of things; so in any delimitation of the phenomenal world as a whole, the noumenal world becomes a realm of things. Now if I define my real world to escape my subjectivity why should I call it my transcendental self? Kant himself refused to do it when he maintained that the logical subject, or transcendental ego, was not a real. I might as well call it an objective subject, or an absolute relative. The contradiction is only thinly disguised in the common language of idealism. This theory finds no difficulty in an *absolute point of view* (or *Absolute's point of view*), as though anything absolute could be a point of view at all. To transcend my point

of view, I am to employ a transcendent point of view. Since in knowledge I must escape subjectivity, I resort to a supreme subject. It is like defining riches as transcendental poverty, or satiety as transcendental hunger. Suppose an orifice through which light shines upon a wall: the disk is then due to the orifice. Remove the orifice, and the generally diffused light is due, according to the transcendental idealist, to a transcendental orifice.

But possibly we do this type of idealism an injustice through not advancing in its behalf the direct and positive argument for consciousness in consideration of its synthetic function. This argument is sufficiently obscure to make one fearful of stating it in behalf of another; but it seems to mean that truth is a gathering up, systematizing, or relating of terms, and that such is exclusively the property of thought. Now I may see the logical evidence for a connection without seeing any evidence for the dependence of that connection upon my seeing. My judgment does not attest its own indispensableness. Only a later judgment can so define my first judgment as a judgment at all. The judgment so discovered has, moreover, an individuality or numerical uniqueness that forbids the definition of its object in terms of it. Were the triangle constituted by the defining thought of it, there would be a triangle for every such judgment, but no such thing as a triangle. That truth is a synthetic activity of thought must be a psychological truth, *i. e.*, it has reference to my access to truth rather than to truth itself. It is biographically true that when I apprehend a law, or principle or definition, I comprehend a number of terms together and in relation. I reach the truth by combining, as, notably, in the case of my knowledge of similarity. But it would be folly to claim that therefore things are made similar by their combination in my experience. Things are not made similar by seeming similar. In seeming similarity there is doubtless a peculiar unity. Two similar seemings will not make a seeming similarity. But this has to do with the peculiar relational character of the psychical manifold, and not with the truth of similarity. It is true, of course, that a succession of feelings is not a feeling of succession, but this does not point at all to the

dependence of the former upon the latter. It is the transcendentalist's favorite complaint against the empiricist that he confuses psychology with logic, but his own arguments for idealism turn upon this very confusion. His psychology of thought is an improvement upon the crude associational theory, but they are none the less psychology. And in the metaphysical use of his theory he identifies the object of knowledge with the knowing. He makes being out of the psychology of logic, and by a dialectic that is in this respect essentially indistinguishable from that of the sensationalist, he defines the real in terms of that activity, purposiveness, or category of objectivity which he regards as the most important factor of the knowing state. Indeed, he quite frankly acknowledges that metaphysics and psychology coincide in the conception of the self. There is space here for only a brief independent consideration of this conception, but sufficient to do justice to its serviceableness as a general ontological principle.

Self-consciousness is introduced to terminate the series of relativities defined by a perceptual idealism. If A be for B, B for C, and C for D, there must eventually be an M, such that while A, B, C and D are for M, M is for itself. The difficulty here centers in the proposition, 'A is for itself,' which for our critical purposes we may treat in a purely dialectical manner. If there be no difference between M and 'itself' there can be no relation between them except that of identity, M is M, which is the category of the thing. If M and 'itself' are not alike, then M_1 is for M_2, and the original perceptual series is prolonged interminably, or $M_1 - M_2$ must be regarded as a unique and organic relationship itself constitutive of a new thing N, which itself does not derive existence from relation to a mind. So we must either content ourselves with a world that is phenomenal and face the contradiction that is virtually contained in such a proposition, or consent sooner or later to regard the terminus of thought as a thing not constituted by that thought. And such a consent is in reality prior both temporally and logically to the conception of subjectivity. The error here is substantially the same as that which lies at the root of the other two transcendentalist arguments; the terms of psychology are mis-

applied to a totality of which by definition they signify only an abstracted aspect. The term consciousness has reference to relativity and exclusion within a world of reals, and therefore cannot signify a principle constitutive of that world itself.

It is the chief interest of faith that certain values shall survive and be consummated. If consciousness be either a specific and unique kind of thing, as certain so-called 'spiritualistic' philosophers would have us believe, or a general form of all being, it cannot be centrally important in such an issue. But if taken to signify selection within the realm of things, then, though it cannot be the ontological first principle, yet as the most general category defining a self it will apply either to psychology or the religious aspect of metaphysics. It must be admitted that error is an outstanding problem. But that circumstance is at least equally difficult for the subjective idealist. Grant him his absolute subject, and finite experiences with their relativity and exclusiveness are a totally new problem, which the general and innocuous pervasiveness of consciousness does nothing to solve.[1]

[1] The MSS. of this article was received on April 12, 1904.—ED.

RETINAL LOCAL SIGNS.

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Retinal Local Signs.[1]

While the existence of some sort of local sign is generally regarded as almost self-evident, the hypothesis regarding their exact nature vary materially not only in their account of the constituent elements, but also in their estimation of the relative significance of these elements. Lotze, in his initial discussion presented, as is well known, three different hypotheses. Under all the various modifications, however, he conceived the local sign as a motor consciousness supplementary to the original retinal impression. His first two hypotheses are alike in their general nature in that each presupposes a physiological mechanism by which the stimulus from each point of the retina is transferred to the nerves of the orbital muscles. According to the first hypothesis the stimulation of each point through an 'interweaving' of the nerve fibers from the surface of the retina and the ocular motor nerves, causes an eye movement definite enough to bring the fovea immediately to the point of excitation. In the second hypothesis the retinal points are not supposed to have such an exact coefficient of movement, but with each point is associated only sufficient motor impulse to start a movement in the appropriate direction. Lotze regarded this latter hypothesis as the more probable. As a third hypothesis a theory of association is merely outlined and rejected without further elaboration.

Recent experiments have greatly increased the improbability of Lotze's second hypothesis, *i. e.*, of a continuous succession of motor impulses arising from a successive stimulation of the retinal points between the point of original excitation and the

[1] Read in part before the Section of Anthropology and Psychology of the New York Academy of Sciences.

fovea. It is now pretty well established that except for movements in the vertical and horizontal planes, the eye does not move in straight lines, and, in the second place, it has been shown[1] that during continuous eye movements from one point of regard to another there is no new effective stimulation of the retina which could occasion the successive motor impulses.[2]

The purpose of this article is to present some new experimental data as a contribution to the discussion of the first Lotzean hypothesis which still appears as a more or less important factor in practically all current accounts of retinal local signs. In a report of their experiments on the angle velocity of the eye, Dodge and Cline called attention to certain errors in the immediate fixation of eccentric visual stimuli. As these inaccuracies evidently concur the normal functioning of the motor impulse it seemed worth while to determine their extent and frequency.[3]

As a result of preliminary experiment the position of the stimulus to movement was arbitrarily fixed in the first series of measurements at forty degrees to the left of the primary fixation point. The stimulus itself was a bright point of light about eight tenths of a millimeter in diameter, made by exposing a ground-glass incandescent bulb behind a perforated screen. The observers *A* and *B* were respectively Professor Dodge and the writer. The ratio between the angular displacement of the eye and the displacement of the lines on the photographic negative was determined empirically. Since these measurements were concerned with errors occurring only in the vicinity of forty degrees to the left of the primary line of regard, it was necessary to determine the value on the negative of some unit of movement between thirty and forty degrees. Under the conditions maintained in the succeeding experiments the lines representing on the negative five-degree movement of the eye between 30°, 35°, 40° had the following values:

[1] PSYCH. REV., Vol. III., pp. 454–465.

[2] *Ibid.*, Vol. VIII., pp. 145–157.

[3] The experiments were performed at the Psychological Laboratory of Wesleyan University and were undertaken at the suggestion and under the generous coöperation and supervision of Professor Dodge. The registering apparatus used was a modification of the Dodge-Cline photographic camera described in this REVIEW, Vol. VIII., pp. 147–151, and in its recent form in the *American Journal of Physiology*, Vol. VIII., pp. 308–310.

For *A* the average of twelve five-degree movements was .54 mm., with a M.V. of .039 mm., *i. e.*,

$$1^\circ = .108 \text{ mm.}$$

For *B* the average of seven five-degree movements was .5 mm. with a M.V. of .06 mm., *i. e.*,

$$1^\circ = .10 \text{ mm.}$$

The following table, Table I., shows the frequency and extent of the corrective movements occurring in the movements of the right eye through forty degrees (*i. e.*, from approximately the primary position of the eye to a point of stimulation forty degrees to the left of the primary fixation point). They are in some cases positive, *i. e.*, the first movement of the eye fell short of the point of stimulation, making necessary a supplementary movement in the same direction, and in other cases they are negative. The positive movements are denoted by plus signs and the negative by minus signs on the right of each column.

TABLE I.

TABLES SHOWING THE EXTENT OF THE CORRECTIVE MOVEMENTS MADE BY THE EYE IN MOVING FROM THE PRIMARY FIXATION POINT TO A POINT OF STIMULATION 40° TO THE LEFT.

I. Corrective Movements of *A*.			II. Corrective Movements of *B*.		
1.	.20 mm.	+	1.	00 mm.	
2.	00 "		2.	00 "	
3.	.14 "	+	3.	.14 "	+
4.	.12 "	+	4.	.12 "	+
5.	00 "		5.	.19 "	+
6.	.13 "	−	6.	00 "	
7.	.10 "	−	7.	00 "	
8.	.27 "	+	8.	.13 "	+
9.	00 "		9.	.24 "	+
10.	.18 "	+	10.	.12 "	+
11.	.13 "	+	11.	.26 "	+
			12.	.22 "	+
Average, .116 mm. (= 1° 42′)			Average .118 mm. (= 1° 10′ 48″)		

Summary.[1]	No.	Per Cent. C. Mvts.	No. P. & N.
A	11.	72 $\frac{8}{11}$%	5 +, 3 −
B	12.	66 $\frac{2}{3}$%	8 +

M.	M. V.
.116 mm. (= 1° 42′)	*A* .056 mm. (= 31′ 12″)
.118 " (= 1° 10′ 48″)	*B* .079 " (= 47′ 40″)

[1] No. = number of eye movements. Per cent. C. M vts. = percentage of corrective movements. No. P. & N. = the number of positive and negative movements. M. = The average or mean extent of corrective movments. M. V. = Mean variation in the extent of corrective movements.

One corrective movement is omitted from the above table of *B*. It is clearly an abnormal break and divides the whole movement into about two equal parts. Its extent is 1.98 mm., and thus represents an eye movement of about twenty degrees. If it entered into the computation, the average error for *B* would become .24 mm., *i. e.*, an average corrective movement of 2° 24′. Those instances in which the corrective movement is given in the table as zero must be interpreted in view of the limitations of the physical measurements of small differences, more or less exaggerated by certain pecularities of our photographic negatives. The cathetometer read only to .02 mm. making it impracticable to measure any movements of the eye half a degree or less. Moreover, with our present knowledge it is impossible to distinguish minute corrective movements from the slight eye movements found in all attempts to maintain fixation. And, finally, errors due to inaccuracies of definition on the negative which become evident only when the lines are magnified, lead to a probable error in all cases. While this would probably be evenly distributed positively and negatively in the cases actually measured, it makes it impossible to measure minute angles, and consequently renders the mean value that is given slightly too small.

In discussing further the above results, the question arose whether they might not in some measure be modified by short-lived motor habits which the eye seems to acquire with more or less facility. In order to determine the matter a second series of experiments was made in which the angle of movement was varied. In the process of refocusing the relative position of the camera and the source of light was somewhat changed, as was also the distance between the lens and the photographic plate. These changes necessitated a redetermination of the empirical ratio between the angular movement of the eyes and the displacement of the lines on the negative. The stimulus was in this second series exposed at one of three points — at 20°, 30° or 40° — instead of at only 40° (as in the first series). The ratio between the angular displacement of the eye and the lines on the negative was determined for the angle of 30°, 40°. In accord with the results thus obtained .106 mm. in the case

of *A*, and .107 mm. in the case of *B*, is used as the equivalent of a movement of the eye of one degree at forty degrees from the primary fixation point.[1]

The results are given in Table II. Under *A* the measurements of the corrective movements of *A* are given in three columns, under *a* the 40°, under *b* the 30° and under *c* the 20° movements and similarly under *B* the measurements of *B* are given.

TABLE II.

A.

a (Stimulus at 40°).			*b* (Stimulus at 30°).			*c* (Stimulus at 20°).		
1.	.16 mm.	+	1.	.12 mm.	—	1.	.05 mm.	+
2.	.16 "	+	2.	∞ "		2.	.30 "	+
3.	.19 "	+	3.	∞ "		3.	∞ "	
4.	.22 "	+	4.	.14 "	—	4.	.28 "	—
5.	.20 "	+	5.	∞ "		5.	.14 "	+
6.	.22 "	+	6.	∞ "				
Average .191 mm. = 1° 48″.			Average .043 mm.			Average .154 mm.		

B.

a (Stimulus at 40°).			*b* (Stimulus at 30°).			*c* (Stimulus at 20°).		
1.	.29 mm.	+	1.	.23 mm.	+	1.	∞ mm.	+
2.	.34 "	+	2.	.08 "	—	(a)2.	.07 "	+
3.	.36 "	+	3.[1]	.21 "	+		.18 "	+
4.	.28 "	+		.10 "	+	3.	.14 "	+
5.	.36 "	+	4.	.13 "	+	(a)4.	.08 "	—
6.	.29 "	+	5.	.18 "	+		.10 "	+
			6.	.24 "	+	5.	.09 "	+
			7.	∞ "				
			8.[2]	.14 "	+			
				.12 "	—			
Av. .32 mm. = 2°59′24″.			Av. .14 mm.			Av. .134 mm.		

Disregarding the error of movement when the stimulus was 20° and 30° from the primary fixation point, a summary of the 40° movements is given in Table III.

[1] The mean variations for both these units of measurements was (M.V.) .009 mm.

[2] In computing the total error of the double corrections, I have added their absolute values and determined the variation of this sum from the mean rather than the variations of the single corrections from the mean.

[3] For abbreviations see note on page 299.

TABLE III.

Subject.	No.	Per cent. C. Mts.	M.	M.V.	No. of + or −
A	6	100%	.191 mm. (=1°48″)	.023 mm.	6+
B	6	100%	.32 " (=2°59′24″)	.036 "	6+

These tables show, as was expected, a somewhat increased inaccuracy in fixation in the forty-degree movements and tend to substantiate the hypothesis that the earlier results were modified by the successive eye movements of the same angular displacement. At the same time they introduce some new factors into the problem. The unexpected accuracy of fixation in the thirty-degree movements — especially those of *A* in comparison with the 20° movements presents a phenomenon whose explanation is impossible without further investigation. Secondly, double corrections, *i. e.*, two separate corrections in one movement, appear twice among the twenty-degree movements, and twice among the thirty-degree movements. In two of these cases both movements are positive, but in the other two the correction is made by one positive and one negative movement. This is interesting as showing the great variability of eye movements.

In order to compare the inaccuracies of motor innervation with the threshold value of local discrimination, it was necessary to measure the latter for both subjects as exactly as possible. For the sake of more general comparison both the usual method of the discrimination of two points, and a second method, which will be described later, were used. The two points of light employed according to the first method were about 8/10 mm. in diameter, 60 cm. from the axis of rotation of the eye, and at a maximum of 40° to the left of the primary line of regard. They were exposed either simultaneously or but one at a time, and the subject was asked to state at each exposure whether he saw one or two points. The results were in brief that in a series of ten exposures when the points were 5 mm. (or 28′35″)[1] apart, they appeared as one to both observers. When 71/4 mm. or 41′ 27″ apart in a similar series of ten they could be distinguished

[1] As the distance from the axis of rotation of the eye to the point of fixation was 60 cm., the circumference of the circle of which this is a radius was 3771.12 mm. This gives 10.47 mm. as the equivalent of 1° on the circumference of the perimeter, or 1 mm. = — 5′43″.

as two by *A* but not by *B*. When 10 mm. or 57′ 10″ apart they were distinguishable by *B*. In some cases, before the threshold was reached, the subject reported that the single point of light seemed to appear broader than at other times. These cases of course, show the proximity of the threshold.

The thresholds therefore lie between 28′ 35″ and 41′ 27″ for one observer (*A*) and 41′ 27″ and 57′ 10″ for the other observer (*B*). These numerical limits might have been more exactly defined but the results of the second series of experiments seemed to make this unnecessary. The latter series depends upon what appears to the writer to be a more satisfactory method of measuring the fineness of retinal discrimination. Stern[1] determined the width of a just perceptible black line dividing an otherwise continuous whole surface, and regarded the result thus obtained 15″ as a measure of the threshold of space discrimination. But it seems very doubtful whether this is a measure of spacial discrimination at all; it seems rather to be a measure of the least intensity or smallest extent of the stimulus necessary to produce a sensation of blackness, and would doubtless vary for different colors. Gilbert[2] in repeating the experiments under somewhat modified conditions, reduced Stern's measurements to 2.5″. Stratton[3] has measured the threshold by means of exposing motionless points of light in immediate succession one above the other. The disturbing effect of irradiation was thus largely eliminated. His results for the angle of 30° are as follows:

Subject.	Angle.	No. of Cases.	Length of Arc Discriminated.	M. V.
A.	30°	5	29′	5.2′
Bd.	30°	3	18.3′	2.2′
P.	30°	4	63.7′	8.7′

In my experiments, a continuously moving point of light was employed and the smallest extent of movement which gave a definite clue to its direction indicated the threshold value. It has been considered by Stratton a possible objection to his experiments that although the points were actually motionless and only exposed in succession they produced the appearance of

[1] *Zeitsch. f. Psych. u. Phys. d. Sinnes.*, VII., 321.
[2] *Psych. Rev.*, IX., 435.
[3] *Ibid.*, IX., 436.

continuous motion. Since there was, actually, however, no objective motion and the effect was due purely to suggestion, he considered that the subjective illusion might be disregarded. The real justification of the method, however, seems to me not the fact that there was no motion involved, but rather that some form of local discrimination was distinctly included in the process. The important consideration is not the absence of movement, but the recognition of a definite change in position. Stratton has shown that there is no reason for considering these two processes, *i. e.*, the perception of movement and the discrimination of position, independent.[1] For our purpose, however, it is sufficient to point out that, whether the processes are dependent or independent, if observation is always made not only of the fact of movement but of the direction of movement, some element of local discrimination must be involved.

The stimulus used in these experiments with a moving point was, as before, the light of an incandescent lamp with ground-glass bulb which was exposed through a small aperture (8/10 mm. in diameter) cut in a moving slide. The extent of the movements of this point of light was limited by transverse slits, which were one, two, and three millimeters in breadth. By means of these a movement of the point of light of from one to three millimeters in length could be made at the option of the

[1] His conclusion, that the perception of motion is simply a perception of the fact that 'a sensation is changing its space relations,' has however hardly been established. The results clearly contradict the evidence upon which Exner's theory is based and leaves that the more improbable theory. It is recognized, however, that in all such experiments sensations of movement occur without any perception of direction. In the present experiments this was the case in several instances despite the fact that the observer was attempting to discover any clue that he might of the direction of the given movement. Observations of a similar character were made by Stanley Hall and Donaldson with relation to tactual discrimination (*Mind*, 10, p. 571): 'there is no doubt whatever that a distinct sensation of motion occurs without giving any impression of direction in many cases.' This may be due simply to a lapse in attention, or a return to the more habitual reactions, that is, as in the case of these experiments, we are much more accustomed to observe small movements without consciously noting their direction, or it may be due to other causes which may easily be suggested. But it has not been shown that any of these more evident explanations will cover all the facts of the case. The processes involved are evidently complex, and need further investigation and analysis before the relation of the sensations of motion to those of direction may be established.

operator. The contrivance also admitted of the movements being made in either the vertical or horizontal planes. It was found by this method that at forty degrees to the left of the primary fixation point the discrimination of the direction of a single point of light in motion is from seven to ten times greater than the discrimination of two discrete points.

The length of the first movement experimented with was 2 mm. (11′ 26″). The exposures were made in three series, each of eight to twelve exposures; in the first the subject was told that all movements would be in the horizontal plane, in the second, that all movements would be in the vertical plane, and in the third, in either the horizontal or vertical planes. The direction of all the movements in the first series was correctly perceived, in the second series three vertical movements were reported to be horizontal by *A* and one by *B*. But, even when the movement was recognized as being in the vertical plane, both subjects questioned in several cases the accuracy of their further judgment of the direction, *i. e.*, whether up or down. In the third series, all the horizontal movements were again correctly given by both subjects, but the vertical movements were reported horizontal by *A*, and in the case of *B* two out of four vertical exposures appeared as horizontal.

When the movement was decreased to 1 mm. (5′ 43″), the horizontal movements were still reported correctly, but the vertical were variously stated as movements from right to left or left to right, as oblique — *e. g.*, from upper right to lower left — although the subject knew that the apparatus in use did not admit of such movements being made, as a mere appearance of light without motion and as a movement whose direction was not perceived. Small changes in the velocity of the movement also affected the ability to perceive the vertical movements. As these movements did not, however, primarily concern this investigation, no attempt was made to determine the most favorable rate of movement. The appearance of these factors is evidence that the threshold for vertical movements has been reached more quickly than the threshold for the horizontal plane. The latter is obviously below 1 mm. (5′ 43″), but the form of apparatus did not admit of smaller movements in this plane.

Several peculiarities were also noted which were somewhat characteristic of these movements in either plane.

First, the movements, even when correctly interpreted, often seemed to both observers like the passing of some opaque object behind the aperture. Secondly, the movements appeared to be larger than they really were, and finally, *B* especially noted occasionally an act of judgment in which the direction of the movement seemed to be inferred from changes in the size of the stimulus as it came into view and disappeared. Obviously, however, all of these peculiarities must depend on some real differences in local coloring.

A similar series of experiments was made with a different form of stimulus. Instead of a point of light a piece of white carboard, 4 cm. square was used. It could be moved as the former stimulus with exactness in either the vertical or horizontal planes. With this method there were no marked peculiarities evident, such as have just been discussed, the former upper limit of value of local discrimination was somewhat reduced in both the horizontal and the vertical movements. Both observers perceived the direction of all movements over 0.9 mm. in extent. As this was the smallest movement experimented with, the threshold value must be even lower.

This refinement of special discrimination (5′ 8″) has been approached only by the questionable method of Stern. The results of Stratton, as stated above, show 18.3′ as the lowest perceptible area of movement at ten degrees nearer the primary point of regard that in our experiments.

The noticeable disparity between the results of our two methods, *i. e.*, as between the methods in which the threshold is determined with the aid of movement and that in which motionless points are used, does not admit of ready explanation. It might seem quite plausible *à priori* that a high degree of delicacy in the discrimination of two points might be brought about by means of repeated observations of changes in position. Undoubtedly the irradiation of light and the lack of sharp definition must be taken into account, but just how far this operates to lessen the discrimination of adjacent points is undetermined.[1]

[1] The similarly increased discriminative sensibility in the case of motion on the skin was first noticed, I believe, by Stanley Hall and Donaldson, *Mind*, X., 563.

A summary and comparison of the different parts of this investigation leads to the following conclusions. It has been shown in the first place that the mean extent of corrective movements of the eye in fixating a stimulus forty degrees from the primary fixation point was, when no effort was made to counteract the effect of short-lived motor habits, for *A* 1° 42′ and for *B* 1° 11′; when the attempt was made to prevent the formation of such habits, the mean extent of corrective movements was larger, for *A* 1° 48′, and for *B* 2° 59′. In the second place, it was found that the threshold value of local discrimination as determined by method I. was for *A* between 28′ 35″ and 41′ 27″, and for *B* between 41′ 27″ and 57′ 10″; as determined by method II., 5′ 43″ or less for each observer, and by method III., 5′ 8″ or less.

Even under the most unfavorable circumstances therefore (Method I.) the local discrimination at 40° from the fovea in the horizontal plane is much finer than the adjustment of motor impulses as shown by the mean extent of corrective movements made in fixating a point at the same distance (40°) from the primary point of regard. That the delicate local differences shown by methods II. and III. could result from such grossly inaccurate motor impulses seems out of the question.

These discrepancies between the accuracy of the motor impulse and the delicacy of local discrimination necessitate, as I believe, some modification of the traditional view in regard to the nature, or at least in regard to the relative importance of the motor factor. Moreover, the variability of the latter, as shown by the presence of corrective movements of varying magnitudes, is altogether in contrast with the relative constancy of special discrimination.[1]

[1] The Mss. of this article was received on March 4, 1904. — ED.

STUDIES FROM THE CALIFORNIA PSYCHOLOGICAL LABORATORY.

VI. Some Peculiarities of Fluctuating and of Inaudible Sounds.

BY KNIGHT DUNLAP, PH.D.

I. The Effect of Physical Interruptions in Subliminal Phases.

Eckener[1] states that 'subjective' fluctuations in a minimal sound may be readily distinguished from 'objective' interruptions, and in particular, that in phases where the sound is inaudible owing to the 'subjective' fluctuation of attention, an 'objective' or actual physical interruption may be perceived if it occurs. To test this phenomenon, I conducted some experiments in the spring of 1899, in the course of which some interesting developments appeared.

The sound employed in these experiments was that emitted by a telephone receiver in circuit with the secondary element of a DuBois-Reymond induction coil, the primary current of which was supplied by two gravity cells and interrupted by an electric diapason of one hundred double vibrations. The telephone receiver was placed close to the left ear of the subject, who sat in a 'silent room' from which external noises were excluded by padded double doors and specially constructed walls. By means of a noiseless key controlling an electric circuit the subject operated an indicator in the experimenter's room; either a sounder or a kymograph marker, as the case might be; and by a prearranged code of signals was thus able to give his reports. By means of a key the experimenter could at any time break the secondary circuit, and thus silence the telephone receiver without in any way interfering with the

[1] 'Untersuchungen über die Schwankungen der Auffassung minimaler Sinnesreize,' *Philos. Studien*, Bd. VIII., S. 365.

primary circuit. The diapason, induction coil, kymograph, and all accessory apparatus, were in the experimenter's room.

In the first set of experiments the subject's key was connected with a sounder, and he signalled the instants of appearence and disappearance of the telephone snarl by appropriate clicks. By varying the position of the secondary coil an intensity was found at which the fluctuations occurred well, and then in certain of the intervals indicated by the subject as 'empty,' (*i. e.*, in which the sound was inaudible), the sound was physically interrupted for a brief period. If the subject perceived this second death of the sound, he indicated it by a special signal.

Table A gives the numerical aggregates of the results obtained in this way. The first column of figures gives the total number of cases for each subject in which the sound was physically interrupted in an apparently 'empty' interval; the second column gives the total number of cases in which the subject indicated such interruption as having been perceived; and the third column gives the number of cases in which each subject indicated a physical interruption when really no such interruption had occurred. The third column is then a record of errors.

TABLE A.

PHYSICAL INTERRUPTIONS AFTER PSYCHOLOGICAL DISAPPEARANCE OF SOUND.

Subject.	No. Made.	No. Perceived.	No. Imagined.
S.	23	10	1
R.	9	3	0
G.	47	24	0
W.	25	17	3
A.	10	4	1
Bi.	75	34	10
Bo.	17	6	0

In the second set of experiments the conditions were the same as in the first set, except that the subject's key was connected with a stylus writing on the drum of a kymograph, and the operator's key for breaking the telephone circuit was connected with a second stylus writing directly over the first one. Thus the actual course of the experiment was recorded for

leisurely examination. The results of this set are given in Table B.

TABLE B.

	INTERRUPTIONS AS IN TABLE A.		
Subject.	No. Made.	No. Perceived.	No. Imagined.
S.	55	32	7
R.	16	9	0
A.	69	5	0
C.	123	109	27
Bi.	27	10	3
G.	29	18	0

The length of the physical interruption was about 1½ sec., while the length of the average 'empty' interval was over four sec., so the apparent perception of the physical interruption was not due to a failure of the sound to reappear at the expected time. Such expectation, again, could hardly operate, owing to the great irregularity in the period of fluctuation; for so it would have produced a large percentage of reports of interruptions when none occurred.

That the perception of the interruption was genuine in almost every case is evidenced by the small number of false reports, in conjunction with the fact that in the majority of empty intervals no physical interuptions occurred, thus rendering large the opportunities for errors of imagination. Some of the errors were undoubtedly correct judgments delayed in the registration on account of hesitation of the subject to accept his experience as real. This delay occurred in several cases concerning which the subjects were questioned, but usually there was no opportunity of making inquiries until after the exact occurrence had passed from the subject's recollection. The recorded errors in almost every case occurred in empty intervals in which a physical interruption had been made a little earlier and not reported, but in obtaining the data of Table B. an arbitrary rule was adopted, according to which no report of an interruption was accepted unless recorded on the drum within one millimeter (three fifths of a second) after the break in the current. The majority of the accepted reports were however recorded within one half of a millimeter after the break. It should be noticed in regard to subject C. in Table B, that almost all of his errors

were made in the early part of the work, and few after he became accustomed to the conditions of the experiment.

Three of the subjects made rather definite analysis of the conditions attending the perception of the second death of the sound. R. was so surprised upon receiving the interruption for the first time (having previously been given no information as to the nature of the phenomenon sought), that she stopped the experiment to describe it, and even after she had become familiar with it could not repress a feeling of astonishment at each occurrence. It finally became clear to her, however, that while just before the physical interruption she was sure that she was not hearing the sound, as soon as the interruption occurred she felt from her new point of view that she had been hearing it all the time, but had only now realized it.

Quite different was the report of C., who was just as sure after the interruption that he was not hearing the sound as he had been before. The occurrence was not for him the cessation of a sound, for that had absolutely disappeared previously. It was rather the 'bottom dropping out' of some indefinite element in consciousness; to be compared to nothing except the feeling attending the downward start in a rapid elevator. The experience of S. was similar, but of different characteristic. For him the occurrence was largely a feeling of relief, as though the sound had been absent previously, but that now he felt sure there was no further use in looking for it. Sometimes, however, his experience would incline towards that of R., and he would feel that he had really heard the sound all the time.[1]

This experiment shows conclusively that a minimal sound which has become imperceptible through the so-called fluctuations of attention, may yet be 'heard to stop.' But a yet more striking phenomenon was observed by subjects S., R., A., Bi. and C. The sound was in this case made so weak that it was not perceived at all, and was then physically interrupted at irregular intervals; the result being that in a large number of cases the interruptions would be correctly reported by the subject, who however, in the typical cases did not perceive anything corresponding to the commencement of the sound at all.

[1] See Stratton, *Experimental Psychology*, pp. 90–91.

That is, nothing was perceived except the stoppage of the imperceptible note. Two of the records of single tests on this part of the experiment are given in Figs. 1 and 2, in which the depressed portions of the upper line indicates periods of subliminal stimulation, and the elevated portions indicate no stimulation; while perceptions of any thing connected with the sound are indicated by breaks in the lower line, exclusive of the first

FIG. 1.

break, which was made with the drum at rest to indicate the relative positions of the two styli.

The relatively greater perceptibility of the stoppage, as compared with the commencement, of the note, can not be due to any instrumental peculiarity, since we are dealing here with an alternating current of 100 alternations per second, in consequence of which the interruptions by the key, which did not disturb the primary current, would produce no special effects upon the current at the moment of interruption. Moreover, a

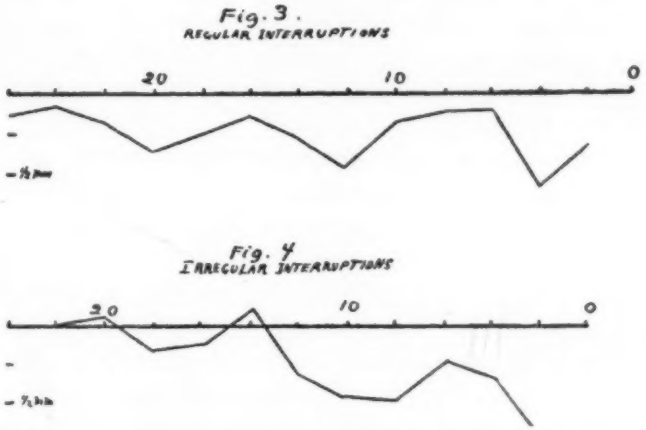
FIG. 2.

similar relation was observed in using distinctly perceptible sounds, in the following branch of the experiment.

Series were taken by commencing with a distinctly audible intensity of the telephone snarl, and decreasing the intensity slightly between each test and the following one, until it passed completely below the threshold. During each test, which lasted about twenty-five seconds, as in previous work, the sound was interrupted, sometimes regularly with three-second intervals,

sometimes irregularly, the intervals in the latter case averaging in the long run about three seconds. The subject indicated these stoppages and commencements as accurately as possible, by depressing his key at each beginning, and releasing it at each ending, his reaction being recorded on the drum along with the physical series.

After determining by careful tests that the latency of the magnet markers was not measurably different for the two movements, *i. e.*, raising and lowering, careful measurements were made of the distances between each stoppage or commencement of the sound, and the registration of the same by the subject. The delay at the beginning was then subtracted from the delay



at the ending, and the results for each interruption in a given test averaged together. Averages for corresponding tests from the other series for the same subject, reckoning backwards from the point at which the sound passed below the threshold, were then averaged together.

We have then for each subject, a series of numbers, positive or negative, or both, indicating the average excess in the delay in recording the ending of the sound over the delay in recording the beginning, through various intensities from perfect distinctness down to complete disappearance. Such a series we can represent by a graph, letting the ordinates represent the values of the successive numbers in the series, and the abscissas

the points on the scale of diminishing intensities to which these numbers correspond. It is evident that a negative ordinate, or a negative value in the series of numbers represented by it, signifies that at that point the stoppage was recorded more quickly than the commencement (cf. figs. 3, 4).

Figs. 3 and 4 show graphs derived from the results of subject S., which are characteristic of the results for all. It is clearly evident from these that the stoppages are in general reported more quickly than the beginnings, and that the difference in this respect increases as the intensity of the sound diminishes.

Since there is no reason for supposing that the reaction time *per se* differs materially in the two cases, and since there is no known aural condition which could account for this peculiarity, the explanation is most probably to be referred to the general conscious conditions governing the superior discriminative advantages of a position in silence harking back to sound over a position in sound harking back to silence. The fact that contrast does play a large part in the perception of the weak sound is further shown by the fact that in all cases a continuous sound was found to be inaudible at a much higher intensity than an intermittent sound under the same general conditions.

The cases of the second death of a sound referred to above are most probably not different in character from the phenomenon just considered. A steady sound, inaudible continuously, or intermittently through the 'fluctuation of attention,' becomes perceptible at the instant of physical stoppage because of the sharp transition from feeble sound to silence. The introspection of the subjects referred to above favors this explanation decidedly. Of course the neural conditions of the phenomenon are yet to seek, but the psychological facts may be settled in advance; in fact they must be, before the neural facts may be safely inferred.

II. The Fluctuation of Diapason and Gas Flame Tones.

W. Heinrich[1] came to a remarkable conclusion that *pure* tones (*i. e.*, tones unmixed with noise) do not fluctuate, but are

[1] 'Zur Erklärung der Intensitätsschwankungen eben-merklicher optischer und akustischer Eindrücke,' *Bull. Internat. de l'Acad. des Sci. de Cracovie*, Nov., 1898, 365–381; also, 'De la constance de perception des tons purs a la limite d'audibilité,' *ibid.*, Jan., 1900, 37–45.

either heard continuously or not at all. This conclusion was based principally on observation of the tone produced by the singing gas flame. Titchener[1] repeated Henrich's observations briefly, and found that his results were apparently confirmed. H. O. Cook,[2] in Titchener's laboratory, had previously found that tones of diapasons show the ordinary fluctuations quite clearly.

The important bearing of these conclusions upon the whole matter of the fluctuation of attention, so called, as well as upon the special features of my own work, led me to investigate the behavior of both diapason and gas-flame notes under the most favorable conditions. This I did in the fall of 1903.

The subject was placed in the silent room mentioned above. A lead pipe has one termination within a recess in this silent room, and the recess is provided with a door by which it can be noiselessly closed, either partly or completely. From the silent room the pipe extends to an ordinary research room on the other side of the building. In this second room was installed the diapason, or other source of sound waves. The intensity of the sound in the silent room was regulated by varying the distance of the source from the one termination of the pipe, or by varying the position of the door over the other termination in the silent room, or by both. The subject, seated at a fixed distance from the orifice, indicated by a prearranged code of signals as before, the periods in which he heard the sound and the periods in which he heard nothing.

An electrically driven diapason of 500 d. v. was first used. The resulting note in the silent room, even when made very loud, was not only surprisingly pure, but was practically simple. The noise of the electric contact, as well as the overtones, seemed to be practically eliminated by the transmission through the long pipe.

The results on four subjects confirmed those obtained by previous investigators; the fluctuations clearly occurred. No experiments on the second death of the tone were made, because of the difficulty of bringing the note to an abrupt termination.

[1] 'Fluctuations of Attention to Musical Tones,' *Am. Jour. Psy.*, XII., 595.
[2] *Ibid.*, XI., 119–123.

Next, the tone of the singing gas flame was employed in the same way. The results were in direct opposition to those obtained by Heinrich and by Titchener, for under favorable conditions the fluctuations were unmistakably observed by each of the five subjects employed. Since the note could be abruptly terminated by bringing a card over the upper extremity of the tube, it was possible to investigate the second death in this case. This phenomenon was clearly observed by at least three subjects, and interruptions made in a subliminal tone were also clearly observable.

I said that the fluctuations occurred when the conditions were favorable. These conditions were somewhat difficult to secure, and demand first, that the tone shall be rather *pure*, second that it shall be *relatively simple*, and third, that it shall have a *fairly constant pitch*.

Let us consider the first condition. Heinrich claims that that gas flame tone is normally pure; much purer than the diapason tone. He argues that the latter is impure from the supposed fact that it will not set up standing waves in a room, while the gas flame tone will. Now the fact of the case is that the diapason will set up standing waves, as can be readily demonstrated in a room not too large. The nodes nearest to the wall may be easily observed, especially if the diapason be insulated from the table and other resonant material so that there may not be waves emanating from points widely separated. The only difference between the diapason note and gas flame note is due to the relative weakness of the former and its relative simplicity, which makes the nodes complete instead of partial as in the case of the highly complex gas flame note.

The diapason note, when the noise of the electric contact (provided one is used) is eliminated, is really very pure. The fourth is the only partial which is strong in comparison with the first and is so weak as to be indistinguishable when the intensity of the note is reduced to moderate intensities; being absolutely neglectable in the case of minimal tones. There is therefore nothing in the tone under these conditions which could generate 'noise.' Nor can it be reasonably claimed that the pipe transmission employed in my own experiment gener-

ated 'noise.' It might possibly have modified the pitch, and that is an inconsequential possibility. The only observable effect was a relative simplification of complex tones due to the disappearance of weaker partials, and a complete elimination of faint noises.

That the gas flame is the source of a very impure tone is readily observed. With certain pressures of the gas supply beats of great strength and as slow (with a four-foot tube) as one per second, may be obtained. Or, they may be increased in rapidity beyond the point of counting. In most cases there are several systems of beats in operation at once, and it is practically impossible to obtain by any adjustment a tone which is entirely free from the roughness (*i. e.*, noisiness), of rapid beats. But with certain adjustments this roughness was slight, and being further reduced by transmission through the pipe, did not prevent the fluctuation. The production of the beats is probably due to the great strength of the upper partials; which leads us to the second condition.

By *relative simplicity* is meant the condition that one note in the complex shall predominate considerably in intensity over the other partials. With a two-foot tube it was almost impossible to get an adjustment of gas and tube such that a note of about three-foot wave-length and one of nine inch length were not about equally strong. When reduced to extreme faintness this compound was heard continuously, if at all; but when made strong enough so that the pitch was perceptible, the note heard alternated between the two, showing a selective fluctuation of attention which would prevent the disappearance of the note completely.

As regards *constancy of pitch*, the gas flame tone is also apt to be deficient at times, as may be noticed by observing the variability in the number of beats which it makes with a steady tone from some other source. This inconstancy is at other times so small as to be neglectable, but there is always a possibility of its occurrence. It is perhaps due to variations in the temperature of the air column in the tube.

In addition to these factors which tend to prevent fluctuation, there is another which is not peculiar to the gas flame

experiment, but yet seems to be especially strong therein. This is the persistence of after-images of the sound, which tends to bridge over gaps which would otherwise be caused by the psychological disappearance. At times, when the tone was shut off without abruptness, the subject would continue to hear it for a minute and a half after its physical disappearance. Why there should be more difficulty from this cause with gas flame tones than with other tones, I do not know; but such seems to be the case, so far as my observation goes.

Such inference regarding the influence of 'purity of tone' as can legitimately be made from my own and others' experiments, is that the advantage as regards case of fluctuation is on the side of the purer tone; and on the side of the simpler tone as against certain types of complex tones, as regards disappearance at least. The fluctuations of a certain type of complex tone of moderate strength may however be more marked than those of a simple tone, if we consider the *selective fluctuation* mentioned above.

The apparent contradiction of the first of these inferences by the easily obtainable fluctuation of such 'noisy' tones as the telephone snarl and watch ticks is not serious. The telephone snarl is highly complex, but not very 'noisy' after all, especially when reduced to its lowest terms; and the complex is not capable of ready resolution by selective attention. The ticks of a watch, on the other hand, vary physically so that they cannot be used as a criterion of any sort.

Noisiness, as distinguished from mere complexity of tone, can be considered as nothing else than *beat quality; i. e.*, shock, or jar, which is the characteristic thing about beats in an otherwise smooth tone. The function of beats in preventing fluctuation is closely connected with the 'second death' of the minimal tone. The sharp contrast between the minimal sound and the succeeding silence is perceptible although the sound was imperceptible up to that moment. Such contrasts occurring with sufficient frequency may prevent the pulsations of the thus marked off sound from ever clearly disappearing unless the intensity be weakened below the point at which the contrast is perceptible; in which case no sound will be heard at any time.[1]

[1] The MSS. of this article was received on April 2, 1904.—ED.

SOME OBSERVATIONS ON VISUAL IMAGERY.

BY DR. H. B. ALEXANDER.

With all that has been written on the subject of mental imagery, it yet seems certain that there is much to be done and said before we are to have a serviceable clearing up of the phenomena. It is possible that we have learned all that we may by the usual 'breakfast table' questionary, or like methods[1] relying upon uncritical introspection. There is too much danger of suggestion and fable and the trickery of language for the results to be perfectly reliable. When it is possible for one deaf and blind from childhood to use the language of the lost senses with the grace and truth shown by Miss Keller, more than ever must doubt be cast upon ordinary wordings as description of psychical events. The tact and deftness of such descriptions as 'white darkness' applied to dense fog, 'luminous shadows' to a river's reflections of trees, the most consummate literary skill well might envy and only an unusual visual sensitiveness would seem likely to suggest.[2] But while the need for caution is thus stressed, the desirability of careful observation is not at all gainsaid. Rather, now that the general characteristics of imagery are fairly determined, it is the more urgently called for; theories as to imagery cannot be on sure ground until we have fuller detail, and the detail is only to be acquired from trained introspection.

The nicety of discrimination demanded for just observation

[1] Such as that of M. Ribot: "J'ai toujours procédé de la mème manière, en disant au sujet: 'Je vais prononcer plusieurs mots; je vous prie de me dire immédiatement et sans réflexion, si ce mot n'évoque rien daus votre esprit, ou s'il évoque quelque chose et quoi?' La réponse était notée aussitôt; si elle tardait plus de cinq à sept secondes, elle était considérée comme nulle ou douteuse."—*L'Évolution des idées générales*, p. 131. The present writer conducted in 1896 a series of similar experiments interestingly corroborative of M. Ribot's results.

[2] See *The Story of My Life*, by Helen Keller, pp. 21 and 39 (New York, 1903).

can only be known in the attempt, and at the best the results are far from indubitable; the mind too inevitably permutes and falsifies its own states, too constantly alters its phenomena under the influence of interest. I emphasize this merely that I may not seem to invite disregard of the personal equation nor to fail to reckon in the idiosyncratic distortion unavoidable to the study I undertake. This study is based upon memoranda covering a period of several years, noting the experiences as they occurred, and so having the advantage of representing psychical happenings induced in the mind's normal course, usually with no thought of special observation. I might add that the personalism necessary to the discussion appears to be permissible only in view of the general significance which I believe the facts to have. These facts are in themselves of an essentially tame and usual type,—which should constitute their chief value.

I. General Analysis.

I shall begin with a general analysis of grades and types of visual imagery. With reference to vividness, three grades or intensities are to be discriminated.

1. There are the fleeting images of common thinking. They are vague, fragile and ephemeral, only by chance to be observed, the moment they attract attention transforming themselves to grade 2. They may be pictures of things or typographical images.[1]

2. Whenever any image is fixed in attention, it becomes distinct in outline and seemingly filled in with substance. The liminal quality in this grade is of a tenuous, 'watery' sort, but if the thing imaged is naturally of distinctive color, the color is

[1] M. Ribot (*op. cit.*) recognized as a peculiar variety of his 'type visuel typographique' the imagery of compositors, finding his differentiæ in the facts that the compositors he examined (1) saw the words given in a particular typography, sometimes named, and (2) for semi-concrete words had accompanying picture images, for abstract words no images. I myself worked some years at the case, and I have many typographical images. But such images are certainly not traceable to the types, which seems to be M. Ribot's conception. The compositor always reads the letters *upside down*, and in handling the type depends quite as much on touch as on sight. As for the instances where the type face was named, I, as a typesetter, might very well describe my typographical images as in 'ten-point roman,' but such description would mean no more than technical familiarity with type sizes.

sure to appear. Thus *dog* calls forth only a colorless (gray) figure of a dog, but *Spot* summons the image of a particular, black and white, shaggy dog. The color element varies from the black and gray (pure white is difficult) of typographical images to a versimilitude hard to differentiate from reality. With the exception of the typographical, the images all appear small, *i. e.*, as miniature copies of the things they represent. Furthermore, they are commonly isolated; there is no background of non-related objects. A landscape may be presented, but it is seldom full or distinct unless enlarged to grade 3.

3. In the third grade images are richer in detail; there is illumination as of a stronger light thrown on, though the color scheme *qua* color is not altered; there is added substantiality and a filling in of background; and the images appear to be of the actual or approximate size of things as viewed from a normal standpoint.

It will be seen that the three grades pass perceptibly into one another. In general, the variation in distinctness of outline or figure is minimal; variation in definiteness of content (as smooth to shaggy) is greater; variation in substantiality is still more pronounced, and variation in color, luminosity and apparent size is greatest of all. In imagery subject to volitional retention the vividness is directly proportional to the attention bestowed. Of the imagery as a whole, the conspicuous characteristic is fragmentariness; seldom save by effort is a whole object seen, and within the given content there is usually one portion more striking, distinct and detailed than the remainder.

In addition to the three grades, there are to be distinguished two types or classes into which the images fall. These are:

α. Voluntary or memory images; all images that may be called to mind or retained by an act of will. Memory images, in the simplest sense, afford the typical instance, but I include along with simple reproductions all images consciously constructed from remembered elements, as, for example, a geometric figure, a landscape ideally composed in accordance with the elements furnished by a description, or a mechanical device illustrated in imagination.

β. Spontaneous and irrelevant images, the salient character-

istic of which is that they seem to determine their own occurrence, coming and going of their own accord. Of course these images can be retained or reproduced in memory, but the retention or reproduction involves a change of quality: it removes that asset of surprise and perversity which gives so much of their forcefulness, and usually it projects them into new associational environments and new spatial contexts.

By 'spontaneous *and* irrelevant' I imply a partial disjunction. Spontaneity characterizes the whole group; irrelevance is a usual but not invariable feature. By irrelevance I do not mean necessary absence of suggestion, but its lack of rationality. Indeed, if the province were dominantly ratiocinative 'irrationality' would be the better word. To instance: If in reading, say, the description of Cleopatra journeying to Cydnus, I imaginatively build up the picture, though with all the royalty of Shakespearian imagery, the act differs not greatly in kind from an act of memory, for I can use only materials selected from the memory store.[1] But if, as I read, in place of Cleopatra

> O'erpicturing that Venus where we see
> The fancy outwork nature, —

I meet here, suddenly, exasperatingly, a grotesque negroid face, this I call an irrelevant image; it is a perverse and irrational intrusion, insulting alike to Shakespeare's lines and to the intelligence before which it presents itself. *A posteriori* there is traceable some associational suggestion,— Cleopatra being an African; but taken as a type, it is very like a prank of secondary personality. Indeed such images argue two planes of intelligence in the apprehension of meanings: there is, first, the plane of constructive coördination, or rational synthesis; there is, second, the plane of uncritical association, with an isolative intelligence incapable of just or proportionate assembling of imagery. Frequently, however, images of the β type show no discoverable connection with the conscious context; spontaneity and temporal independence are their sole differentiæ.

[1] I purposely discount the imaginative fervor which really gives such construction more vitality than is common to memory.

II. Projection and Size.

A satisfactory criterion of the externalization of images is difficult to obtain. In my own experience, all visual images appear in a field of vision, therefore, in that sense, as external; they never seem to be 'in the head.' They are not, however, all external in like sense; not all appear in the space which I sensibly perceive or am conscious of as real; there seems to be truth in the notion of a 'mental eye,' and it seems to perceive in space-relations of its own. Thus it is quite possible to compare a memory image with an after-image, although the two are assuredly not present in the same space. Nor is the discrimination of spaces dependent upon vividness; the memory-image is often more vivid than the after image, and it may, as at dusk, be more vivid than an actual perception. William Blake affirmed of his own imagery — from which his wonderful drawings were directly copied — that it was 'infinitely more perfect and more minutely organized' than ordinary perceptions. Further, Blake discriminated these images very explicitly from externalized or projected images — a 'ghost,' as he put it, he had never seen but on one occasion, when he beheld a repulsively spotted being on the steps of a house.[1]

I distinguish, then, as 'mental' images, those which have disjunct spatial contexts of their own; *bona fide* projections are images that intrude upon what one is conscious of as real space. This does not mean that the imaginary space is not external in the sense of being in a field of vision; but it is distinctively an imaginary space, related to the mind's eye. To talk about its internality or externality at all borders on absurdity; it is simply not included in the space system of which body and head form a part.

But it is not unusual for images in imaginary spaces to plunge into real space. The mark of their advent, and, I take it, the safest criterion of projection, is their modification of actual sense-perception. When a portion of the perceived surfaces of things is blotted out to give place to an image — as when a picture appears upon a printed page and hides or blurs the print — then projection takes place. Thus it is relation to objects of perception that is the determining factor.

[1] See *William Blake*, by Alfred Story (1893).

Effort has been made to distinguish very sharply between imagery that affects sensation and imagery that is purely ideational on the hypothesis of distinct cortical centers,[1] and this may very possibly be a just discrimination, but it certainly cannot sustain any very sharp cleavage of a subjective character. When I speak of images being projected, I mean that sensible ideas become sensation (that is modify sense-perception) without any material alteration of character and content. This is not a case of hallucination or of pseudo-hallucination (if this *means* hallucination), but it is the case of a visual mental image becoming a visual physical image, and being recognized as such. I imagine that images so projected are really what is meant by 'pseudo-hallucinations.' Professor James' account of these, characterizes very well images of the β type, when projected as I have described: 'From ordinary images of memory and fancy, pseudo-hallucinations differ in being much more vivid, minute, detailed, steady, abrupt, and spontaneous, in the sense that all feeling of our own activity in producing them is lacking'; further, they are 'projected outwards.'[2]

As a matter of fact, there is no hard and fast line between sensation and sensible imagery. Even the criterion suggested, of spatial interference, is not of indubitable application. I recall an instance in which an apparition-like image appeared directly over the shoulder of a person with whom I was conversing, so attracting my attention as to elicit query concerning what I was seeing. The image occupied a perfectly demarkable locality, toward which my eyes were visibly accommodated, yet I was not then aware that the real space was in any sense infringed upon and was perfectly aware that the image was of the fancy. As bearing upon the correlation of spaces, I note that many times projected images appear sequent to winking; I have

[1] See *The Nature of Hallucination*, Boris Sidis, PSYCH. REV., N. S., XI. 2. The statement (p. 128) that 'ideas and sensations differ fundamentally, they differ in kind and no amount of ideational activity can ever be made to become sensory in nature,' if it really means that mental imagery cannot be projected in the sense defined above, can hardly be accepted; the reverse is observably true in every respect except continuity of spatial context and even the ideational space may be considered as subject to projection when we consider the anomalous smallness of some projected images (see below).

[2] *Psychology*, II., 116–117.

repeatedly become aware of previously unnoticed imagery in this way. It would seem that a blanking of the retina to outer stimuli were necessary to the apprehension of these images, which, afterwards, are enabled to maintain themselves for an appreciable time in competition with sense-perceptions. Such images always appear in specific space,—on the wall, the page of a book, etc.

In this connection, it may be in place to offer demur to Professor James' categorical assertion that it may be stated 'as a universal proposition that after-images seem larger if we project them on a distant screen, and smaller if we project them on a near one, whilst no such change takes place in mental pictures.'[1] This is a usual, but not an invariable rule; some mental images follow precisely the law of after-images, indicating similar retinal excitation. For example, after an evening at chess or whist, I have observed, even at an interval of an hour (surely an impossible intermission for the advent of a positive after-image),[2] projections of chessmen or pips suffering the same distortion and alteration of size as ordinary after-images. Again, the occurrence of an image on the page of a book is plainly conditioned by the angle at which the book is held and is liable to distortion to suit this angle.

From the foregoing it will be seen that there is no universal distinction between 'mental' and projected images, and after-images. It is true that the latter are manifestly of sensory occasioning, but it seems also certain that all projected images involve retinal excitation. A difference of importance, though a relative one, is the ephemeralness of the evicted central imagery, — in my case, quite unable to stand up against incom-

[1] *Psychology*, II., 51.

[2] These images also differ from after-images in being wholly ephemeral, having not more than a second's duration, whereas an ordinary after-image may endure a minute or more. Professor James cites Meyer: "Most of these subjective appearances, especially when they were bright, left after-images behind them when the eyes were quickly opened during their presence. For example, I thought of a silver stirrup, and after I had looked at it a while I opened my eyes and for a long while afterwards saw its after-image." I do not see that this is not a case of simple projection, unless, as Professor James infers, negative after-images are meant. I have observed colored images to project themselves in black and white, but this I lay to their inability to compete with sensuous luminosity and to the fact that the color element is the weaker in my visualization.

ing stimuli. The various differences between after-images and imagination-images which Fechner has noted,[1] I find to hold either not at all or to only a partial extent. After-images are for me no more coercive or involuntary than images of the β type; they are neither brighter nor sharper in outline than other images may be; and though usually 'unsubstantial and vaporous,' this is not necessarily the case. On one occasion I placed a new silver coin on the palm of my hand, in bright sunlight, for the purpose of getting a negative of the design. I had no thought whatever of the hand. On closing the eyes it was with a shock of utter unpreparedness that I beheld a tiny hand as substantial, detailed, truly colored and formed as an actual perception. The surprise was so complete that for an instant the image was a veritable hallucination. With the eyes open it enlarged and dissolved in the usual fashion.

The tininess of this image is worth note. It brings up the whole interesting question of size in visual imagery. With me, and I presume with most persons, all after-images appear small when viewed with closed eyes or in pitch darkness. A window seen from a distance of seven or eight feet, as an after-image, contracts to a seeming height of two or three inches. The contraction is not instantaneous, though it must be particularly heeded to be observed *in transitu*. The size indicated remains nearly constant (so long as the eyes remain closed) during the changes attendant upon dissolution.

The small size characteristic of after-images with the eyes closed holds of most mental images where no effort is made to realize a just magnitude. Smallness, in fact, seems to be one feature of the spatial independence of these images. For the shrinking of after-images, the taking away of all the hints by which we commonly judge perspective might seem a sufficient account, and similarly abstractness an explanation of the smallness of centrally occasioned imagery; but *a priori* there seems to be no reason why an image should assume one size rather than another. Some help may be gained by reference to actual space perception. Chance juxtapositions often startle us by their emphatic contractions of the third dimension, and by

[1] Cited by James, *Psychology*, II., 67.

a sufficient effort one may very nearly free oneself from perception of this dimension. By attentively envisaging a house, for example, one may observe it gradually flatten out and shrink into a diminutive toy house.[1] But there is a limit to this contraction, a norm of diminutiveness beyond which it cannot go. Apparently the factors that determine this limit include besides narrowing of the attention, so as to eliminate the signs that ordinarily give perspective, some direct relation of physical and conceptual conditions.

I venture as a guess that the normal shallowness of space is a sort of sense generalization, a perceptual construct, determined by the focus of most distinct vision — that is, at about reading distance,— and that the size of images, relative to the area stimulated, is dependent upon the horopter at this focus.[2] An object at this distance stimulating an area equal to the area stimulated by a house at a hundred feet would then give the abstract or normal size of the visual idea of the house, which must hence appear very small if envisaged as a whole. But it is obvious that if all images are reduced to the same or approximately the same absolute size, they will not all be reduced in like proportion; objects naturally smaller will seem relatively less reduced. This is actually the case, the limiting instance being furnished by typographical images which appear undiminished because they are presented at the normal reading distance. We thus get an explanation of the usual lack of true proportionality of mental images.

It is not to be supposed that small images are universal. Many people either do not see images as small, or, if they do, they still reckon with space and judge the objects as if seen at a distance sufficient to account for the size.[3] Possibly it is only the

[1] Apropos, I vividly recall that on the first railway journey of which I have recollection (at about the age of four), I was amazed to see tiny people, tiny cattle and houses, all but a few inches high yet all as real as reality. There were whole fairylands through which I was whisked, but with imperishable glimpses retained. No scepticism of my elders could abash my conviction, for what I saw I saw with my mortal eyes.

[2] So far as I have been able to judge the process is independent of actual accommodation, which would rather discount the kinæsthetic element. In the reverse case, however, of imagining an image enlarged, kinæsthesis seems clearly present.

[3] So a friend testifies.

bookish who find the ideal world crowding so close; and in any case it is possible to enlarge all imagery subject to volitional retention either by a fiat extension of the third dimension or by imaginatively filling in the detail that creates perspective, though each process involves effort.[1]

III. The Imagery of Dreams.

The imagery of the state bordering on sleep is so distinctive in an empirical way that I have a somewhat coercive feeling that it ought to be placed in a class by itself. At the same time I can discover no certain characteristic differentiating it from the type β; the main differentia from other instances of this imagery is greater duration with an aptitude for evolving under the eyes from one form to another, but the evolution is so palpably a consequent of the duration, and the duration so plainly due to the freedom from sense or thought competition in the state of semi-sleep, that this differentia is of little account.

It is possible that these images arise in connection with idioretinal light or some internal disturbance of the eye,[2] after the manner of 'fortification' images, but in no case will this account for the intrinsic character of the images — that is, as representations of ideal things,—and in any case there remains a residue of manifest central origin; there is no ground to suppose that the retina can itself create imaginary portraits or

[1] Not to place too much weight on the mechanical features of vision, it is well to bear in mind the analogous smallness of auditory images which to many people, especially when overworked and nervous, take the form of imaginary *whispering*. Though weak in auditory imagery I have occasional snatches of music having a peculiarly phonographic diminutiveness. It should be noted, too, that there is some variation in the focus of imagery — if I may so call it. An after-image of a lighted lamp, with closed eyes, appears at about the distance mentioned; but if the image be taken with one eye only, the other being left open, it is appreciably nearer. Of course the contrast with the extension seen by the open eye might very well account for this.

[2] Compare the statement of Dr. Sidis, in the article cited: "Often in closing my eyes and keeping quiet, so as to become somewhat drowsy, and watching the field of vision, not directly, but, so to speak, from the corner of the eye, animals, figures, faces, can be seen forming and dissolving into mist. These phantoms can be directly traced to specks of light and masses of color coming from the retina and especially from the macula lutea." The certainty of this origin seems to me far from apparent.

evolve ideal representations consistent with, yet differing from, reality.

The persistently sensational feel of this imagery would, however, seem to warrant the inference of some physiological element, obscure though it may be. That there may be a kinæsthetic factor involved is at least suggestively hinted by an experience which I may cite: While reading, both hands beneath the book, I became drowsy, my eyes closed and my head seemed to fall forward. Just as, or just after, my eyes closed, a face appeared directly before them,—a man's face, thoroughly Mongoloid, excepting the eyes which were full, open, brown and very bright. As I saw the face, it seemed to fall toward mine, the eyes at the same time closing so that I saw the lids droop; there was also a vague image of a hand raised to catch the head. The image appeared with a vividness sufficient to rouse me completely. It is to be noted that my eyes did close, my head nodded, and although my hand did not rise up, my first feeling after the surprise was that this hand somehow seemed unsatisfactory, as if it ought to move. On several other occasions I have noted the same phenomenon of an image of closing eyes in connection with the drooping of my own lids. Such images seem to indicate the *translation* of an affective state into a form of cognition, of a subjective feeling into an objective representation. In a grade of conscious life where mental process has reference solely to near activities the like function might well possess vital significance.

The general character of borderland images is fairly described by Professor James' account of pseudo-hallucinations; they are relatively 'vivid, minute, detailed, steady, abrupt and spontaneous.' I find them also diminutive, projected to but a few inches, mutable or self-changing, usually fragmentary, and frequently grotesque or odd. To give instance: On one occasion I saw what seemed to be a living cartoon of the face of a friend, a microscopic exaggeration, yet perfectly recognizable. Again, a woman's head and shoulders, the head thrown back with strong light and shade on the features; the face of a primitive savage type, prominent cheekbones, wide zygomatic arch, prognathous jaws, the mouth open showing large irregular

teeth; the eyes were in the shadow of heavy brows, the hair was low on the forehead, the neck very muscular. On another occasion, a Dantesque nose and brow which gradually filled out to full profile and lengthened into a vapid expression of mock piety, the whole irrelevantly giving place to a thick-lipped mouth with rows of teeth widely shown.

Preponderatingly these images represent faces of men or imaginary animals (the order of frequency I judge to be: eyes, mouths and noses, profiles, full faces, bodies), and it is not an uninteresting speculation — if the like experience is as common as I take it to be — whether such tiny personifications may not have had a deal to do with the development of belief in fairies [1] or diminutive night-folk who come, like Queen Mab,

> In shape no bigger than an agate stone
> On the forefinger of an alderman,
> Drawn with a team of little atomies
> Athwart men's noses as they lie asleep.

Between the imagery of semi-sleep and that of dreams proper there is one marked distinction — that in dreams objects appear to be of the size of real objects. Further, in dreams images do not appear to be images at all, but seem to be the real things themselves. But the latter distinction is subject to our very frequent consciousness of the unreality of the dream state, and even the distinction as to size must be received with caution. In the dream state there is no competing space relation (unless some vague sense of the body's extension), and hence no criterion by which to judge size outside the somewhat vague remembrance of dream consciousness. If a comparison of dream space and real space could be made, it might be found that dreamland is confined to Lilliput. I guess this from two confirmatory experiences. The first was an awakening in the midst of an early morning dream in which a horse drawing a sleigh seemed to be approaching, growing in size as he did so with the rapidity and a good deal of the effect of the moving picture produced by a kinetoscope. Wakened, I became aware of sleigh-bells outside, the approaching sound of which undoubtedly suggested the

[1] At least this seems no more improbable than the usual derivation from a race of pelæolithic dwarfs. Compare, also, the conception of the human soul as diminutive and image-like: Tylor, *Primitive Culture*, I., p. 450.

dream; in addition, I became conscious of having heard the bells in the dream, and also that the visualization had been diminutive, enlarging as the eyes opened. The dream had, so to speak, telescoped, and was retrospectively given a proper extension through the influence of the continuous stimulus furnished by the bells. A second case was the projection of a dream image of a human figure upon sudden awaking. It was one of a group in the dream, and when my eyes suddenly opened, I was surprised to see the figure lengthen out exactly as does an after-image.

On more than one occasion I have had a distinct dream consciousness that the dream experience was one of imagery, not reality; but this I conceive to be a late development, partly due to the nature of my interests. Probably as fair a test of the relative real-seeming of dreams as can be gotten is the duration of dream impressions as compared with memories of real experiences.[1] My own most long-standing memories include at least two dreams which occurred when I was between three and four years old, as I know from the fact that both are concerned with the death of my mother at that time. Except from internal evidence (their inconsistency with reality as I have come to know it), I should not be able to distinguish these dreams from real memories, and of other memories of early origin I am not even now certain. Nowadays, however, I am frequently dream-conscious, and even find myself fully alive to the theoretic interest of a dream state, which I am yet unable to influence. A recent instance curiously illustrates. On January 7 I dreamed that I was being shown a collection of pen and ink drawings and instructed as to their merits. One of the drawings was of a mediæval landscape, and on examination the clouds in the sky proved to be swathed cherubim in horizontal attitude. In my dream this picture seemed very unique and impressive, and on waking I remembered it with great distinctness. On February 15 I dreamed that I was shown this same drawing again, that is to say, I recognized it in my dream; but on awak-

[1] This test is if anything unfair to the dream, since, especially in later life, it offers fewest points of attachment to that systematic apprehension of reality which experience generates and which in turn so largely selects those memories in which experience is preserved.

ing I remembered that what I had seen in this dream had in fact been a chalk drawing on slate of two vertical, or erect, swathed figures, with no landscape at all.

In these dreams and their memory images there is a curious interlocking of the dream world and the real world and an interconnection of dream interests somewhat bearing out the suggested conception of a secondary plane of intelligence. Although dreams are able to create their realities at whim, they yet reveal a rudimentary consistency which is the beginning of law and order. Linking together in memory, even if erroneous, is one step; discrimination of the dreamer's self from the dream world, though it be but a feeling of helplessness in the presence of dream mastery, is a greater step; and finally the advent of intelligent interest allies the dream state very closely with rational experience. In a few recorded instances dreams have actually solved problems which have baffled normal intelligence,[1] and it is worthy of note that they have done this in the form of sensible imagery and in what might be called the dramatic mood of reason.

IV. The Influencing of Imagery.

From foregoing discussions it should be apparent that lines of distinction between different classes of imagery are nowhere fixed and determinate. After-image and imagination-image, projected and non-projected, dream image and waking, all are united by liminal, indecisive cases. The distinction which maintains itself most steadfastly is that between images of the α and β types, between voluntary and spontaneous imagery, but even this distinction will be found to break down to a considerable degree when we carefully examine the influences to which imagery is subject.

In restricting the influence of volition to a certain type of imagery, I have allowed myself an accommodatingly indefinite use of the term. It is a question whether new combinations of elements are ever volitionally predetermined, while on the other hand it is certainly possible voluntarily to influence the occurrence, if not the content, of images other than memory images.

[1] See the cases reported by Professor Newbold, Psych. Rev., III., 132.

After-images, of course, are found by paying attention to them, and in the same way, if one keep on the look-out for imagination images one is sure to perceive them; indeed, I am not at all confident that their liveliness and frequency may not be directly dependent upon an attitude of expectancy toward them, — upon an assumption of incipient rapport with their plastic objectivity. This is not saying, however, that there is involved any predictive certitude as to character; the images always have some degree of surprise in store. Even in the most abjectly servile imagery there is always some spontaneity. It is sometimes held that it is impossible to will an indefinite end, that desire must be conceptualized before it can become an object of volitional effort. Were this really so, we should never will anything at all. The calling to mind of the simplest idea or the merest recollection always introduces some incommensurable element; there is always at least possibility of surprise in the summoned presentation. For example, I entertain the idea of an elephant, willing the image, and instead of the full figure which I have a right to expect, there appears only head and trunk. Further (I cite a specific occurrence), it appears at a certain distance and of a certain (life) size; the head is turned slightly to one side, the tusks are absent. It is perfectly plain that this experience represents a considerable degree of incommensurableness; the formal and final causes by no means square with one another. Volition is thus largely discredited at its inception, wholly unable to free itself from irrelevance and chance.

Moreover, even the general influence of volitional attention in assuming the attitude of expectancy must be guardedly exerted if it is to be effective. If too direct, attention really seems to defeat its object in many cases; often it must be oblique, sidelong, in order to catch that for which it waits. There is needed a peculiar kind of mental passivity — even in connection with the keenest curiosity — where images are concerned. If one too deliberately tries to manipulate them, they simply balk, and more than likely disappear altogether. Of course this does not apply to memory images, though even a memory image is apt to obtrude itself in unexpected garb if left unwatched.

If one may so put it, then, the most direct influencing of

imagery must be indirect, and the further one proceeds from mere reproduction the more the indirectness grows. In ordinary thinking there is seldom a consistent rational nexus between thought and image, doubtless because the thought is too rapid for the imagery to keep pace. At the same time a reflective state of mind, one in which the ideas are chief concern, is decidedly conducive to vivid imagery, however inclined this may be to sport-like characteristics. If the interest be imaginative rather than abstruse the images are naturally more abundant and are also more apposite; and if the imaginative thinking is of sufficient intensity or lasts for some time, it alters the whole texture of thought, frequently for days at a time. On one or two occasions I have undertaken some line drawing, and on these occasions have found a large accession of images in black and white line-work. These images were characteristically spontaneous, with a strong element of surprise, and often they were projected. Usually the specific suggestion or association was quite untraceable, though in one case I recognized the nucleus of a striking presentation in a forgotten penciling of six weeks previous. The image had been subconsciously incubated during this period and at the end hatched forth with all the self-sufficiency of a lusty chick.

While interest is thus to a degree able to contract the range of imaginative experience and intensify its content, it is unable, so far as introspection shows, to furnish any account of actual variations. No element of suggestion, no law of association will quite explain the phenomena. Images frequently bear not even a hypothetical relation to their contextual consciousness. For example, I am quite at a loss for an explanation of the curious ethnological traits or yet of the grotesqueness prone to characterize my imagery. Again, even in the case of memory, images are seldom enough mere reproductions; neither are they mere erosions of former impressions; rather they are veritable transformations, growths, the spontaneity of which is sufficiently attested by the fact that they sometimes surprise to laughter. The problem of their origin and function may be worth a few paragraphs of speculation.

V. Imagery and Ratiocination.

Sumarizing the general phenomena of occurence, it may be stated: First, that the mind tends normally to inhibit a mass of inflowing imagery, either directly through refusal to entertain the presentations offered, or indirectly through ratiocinative or perceptual preoccupation. Second, that the mind is able to create, through interest or suggestion, an imaginative diathesis which, in a measure, overcomes the inhibitory function. Corollary to this is the tendency of the mind so predisposed to sink into an attitude of mere curiosity towards it images, which hence achieve relative independence and self-direction. Third, that a class of images (the β type) bear internal evidence of a process of subconscious synthesis,—that is, the elements of which they are composed in the relations in which these elements appear belong to no recognizable historical experience. This incommensurable element is present to some extent in memory images,[1] but *ex hypothesi* is there subject to limitations.

These facts to my mind make plausible the supposition of a primitive form of plastic intellection, intuitive rather than reflective, yet having the true characteristics of rational thinking — namely, dissociation and ideal synthesis. It is much the habit of writers on ratiocination to credit all mental power of abstraction and construction to the naming-function of language. Even if the generic image is possible, maintains Stout,[2] we have yet to show that it has not been rendered possible by preceding word analysis. It seems to me that such writers rely too strongly upon the supreme significance of language in their own, exact, thinking. Metaphysical abstrusities naturally demand a mobility of ideas which no form of thought limited to space-bound presentations could yield. But this is hardly true of thought in general. Galton found scientists to be nearly devoid of imagery, but women and children were freely endowed with it. The kind of ideas which one entertains makes all the difference in the kind of medium demanded, Language is undoubtedly the supremely facile agent of thought, but it is by no means the

[1] Consult the interesting discussion of *la mémoire pittoresque*, by M. Paul Souriau, in *l'Imagination de l'artiste* (Paris, 1901).

[2] *Analytic Psychology*, II., 176.

only efficient one. For my own part, I find that consciousness of language is keenest when I write; the words group themselves and fall in order far ahead of the pen; yet when endeavoring to master a difficult abstrusity, it is necessary to lay the pen aside; consciousness of language then sinks to a minimum and the conception if grasped at all is grasped in a sense of relationships, it is not mentally expressed. So far as I can observe such thinking quite transcends all use of language or other sensuous element. In an opposite direction, effort to understand geometrical or mechanical conceptions is vastly furthered by mental pictures; an illustration is much the most effectual definition of a machine, a diagram the aptest solution of a problem in space relationships.

It is certain enough that we do reason to some extent in pictures. Whether such reasoning actually precedes linguism may be doubted, but it seems to me that it presents a type of reasoning which might be fairly developed among the higher animals. Where the end of thought is proximate action — and no animal, we may be sure, reasons for any great future — thought should be as rapid and instinctive as possible; and for the saving of mental confusion and waste no surer device could arise in nature than subconscious specialization of thought-processes; reflective consciousness is decidedly the product of biological leisure. Moreover, since an animal's interests are practically all in the world of space, visual images answer his highest need for abstraction, especially since his thought's symbolism must needs be of an unconventionalized, pictographic order.

The mass of imagery, then, which so presses in upon our normal intellectual life may be no more than a ghostly reminder of what was once the sum and substance of thought. The fact that the function of the mental picture has been so largely taken over by language would go far toward accounting for the irrational, dreamlike texture and sequence of the images; they are mere residual mental organisms, pursuing a natural course of degeneration. Possibly the seeming degeneration may be accounted for as the natural inferiority of the mode of thought itself; the image failing to keep pace with the normal growth of mental life. Some such conception, in the case of dream

consciousness, seems to be entertained by Dr. Sidis: "It may be claimed that the dream consciousness is to some extent a reversion to the earliest forms of mental life, when the race was as yet undisciplined by the accumulated experiences of ages of social life."[1]

As bearing upon the suggested view, I venture to cite, also, a suggestion of Dr. Bosanquet's: "It may be that in early soul life this reproduction [of ideas by other ideas] is unconscious, and that its results, the images which it brings before the mind, are not used as ideas, *i. e.*, are not distinguished from fact or known to be symbolic of a content other than themselves. The results of experience may be made available for the guidance of an animal through suggestion effected by reproduction, but not distinguished *as* suggestion from any presented reality. In this process we have something that does the work of judgment and inference, and that has the same fundamental nature with them."[2]

Apropos, it might be added that the better part of all our reasoning is unconscious. I, at least, have never been able to fixate with the mental eye an actual case of conscious disentanglement of puzzle or of clear-seeing conceptual synthesis. What I do find is a preliminary state of confused heterogeneity, mere puzzle, and then a succeeding state of illumination. Order appears from disorder, plan from chaos, but in response to no urgency or coaxing. Knowledge always comes as a precipitate from the psychic solution. Occasionally a significant phrase forms itself and presents itself, perhaps as a typographical image, coming as from nowhere and with no apparent incentive, but usually the process is merely the process of *seeing through*, and it happens with an utter spontaneity not to be distinguished from that of the apparition of imagery.[3]

[1] *Loc. cit.*, p. 110.

[2] *Logic*, II., p. 15.

[3] The MSS. of this article was received April 13, 1904.—ED.

INCIPIENT PSEUDOPIA.

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One of the miseries of my life has been a supersensitive retina. The sunshine on snow or a bare road is often torture. Any cone of artificial light is unendurable. To sit in an electric-lighted room, even with eyelids closed and perhaps with a shade over the eyes, is to forfeit the efficiency of the next day. If I have congestion about the head from grip, fever or cold, then it is an affair of bed, black bandages and darkened rooms. Out of this experience have come some observations which are of interest to myself and may be to others.

The doctrine of the specific action of the senses is well understood. The nerves of the retina are made to respond to light and they answer even mechanical pressure in terms of light. I have been interested in watching, in my hours of darkness, the illumination which I get from the inflammation of the retina. The glory of light seems then turned on at full head. In the interest of clear psychological distinction I wish to say that this light is not subjective — a thing of imagination — it is objective; as it comes from the pressure, against the optic nerve-filaments, resultant from congestion.

Further on we shall see where psychic action comes in, as plainly distinguishable from this illumination, or any of its phenomena, as is such psychic action in any perception which is derived from light that comes from the external world. The field of vision in my case is confined to the optical apparatus itself.

I am satisfied that I see the march of the blood through the arteries of the retina itself. I feel my pulse by seeing it in the retina. It is with some timorousness that I make such a statement, but I make it. The statement rests on the perception of the same phenomena recurrent for many years. I have seen,

under a microscope, the corpuscles of blood dart along the tissue in a frog's foot; and the motion there is similar to that which I detect in my eye; only the march is in open order in the frog's foot, whereas in my retina the order is close. I have tried to verify my conclusion in various ways. The steady onflow I cannot stop nor turn aside by volition. I can talk with friends or open my eyes, but when I settle back and the eyes are shut, there is the same procession of bright particles moving in the same way. This phenomenon comes in when the tension from inflammation is high enough and departs as that tension ceases. In this experience I am sure that psychically I am a passive percipient, I see what I have to.

But the show does not end with the sensation of light and the perception of the procession of the blood. I get an unlimited variety of pictures projected before this interior vision. They are the products of imagination I know, but I have no will power over them. They begin at the edge of this inward horizon, pass over the field and then depart. They come and go at their own sweet will. I can never anticipate what is coming. I can call up, alter or modify nothing. I am as helpless about what the exhibition shall be as one sitting in the midst of an auditory is over the movements of a panorama on which he is looking. I have tried again and again, when a face would begin to appear, to have it take the form of some one familiar or loved, and have never yet succeeded. I am compelled to watch the show that is brought up before me. While imagination furnishes some of the elements of the spectacle, I am sure inflammation furnishes others. For instance, something begins to move along before me and it develops into a full-blown iron-foundry. Everything in it takes on the glow that flashes out in a real foundry when the furnace doors are opened; only the color is uniformly distributed over everything. The tools, the walls, the iron rods, the cinders are of molten-iron color. A heap of cinders is simply a heap of gems, an iron rod is burnished gold. I charge the flame-tint up to motion which I interpret in terms of light. But the foundry and all its appurtenances move along and disappear. I cannot stop it. I cannot call it back. The glow may continue but it

is formless. I have many sights savoring less of inflammation than that of the foundry. I am entertained with landscapes of all sorts; and here again I am helpless. If a landscape begins to move out before me I must take it as it is set. I have tried over and again to turn a starting picture into a vision of my old home, or of some familiar scenery, but it always develops in its own wilful way. There is a beautiful ravine twenty miles from Chicago with a magnificent elm at its head. I have supposed myself starting up that ravine many a time but I have never yet seen that elm in these compulsory imaginative excursions. Within three months I have been sure that I was at the lower end of that ravine and have had high hopes of reaching the elm, but the vision refused to go in that direction and turned me out, apparently on the edge of a wood in central Illinois that I had not called for, and I

"Was left lamenting."

Perhaps I had better give some of the conclusions I have formed. My helplessness in respect to imagination assimilates the phenomena of my visions to those of dreams. But then are we not in our waking moods more than a little helpless in regard to imagination? Do we not then and there have to take pretty much what volunteers in the field? It is a startling, disquieting thought that we have little control over imagination even in our normal conditions. It is the most elusive, evasive, the least tamed of our faculties, the one most inexplicable.

Throughout all these visions I find sensation and psychic action tethered together as in normal sight. The picture is carried forward because it is physically connected with the steady onflow of the circulation of the blood. In these visions I am on the open road to the pseudopia of all delirium. Between what I see and what a victim of *delirium tremens* sees is only a matter of degree. Carry the pressure by congestion on the filaments of the optic nerve far enough, and let some of the brain centers used in coördinating thought and act be involved in the inflammation, and it is easy from my point of experience to see that the vision of imagination might catch and hold the attention to the exclusion of the vision derived from the external world. I might then start to run up my fictitious vale at Brush

Hill or begin to set things to rights or wrongs in my mentally invented foundry. Out of my long experience I have no memory of unesthetic visions. Medically speaking they have been "benign." Landscapes predominate in my panoramas. Though I cannot call up the countenance of a friend the faces I do see are not ugly. Rarely does a human being figure before me. Though my foundry appears to be in working order to the last touch there is never a soul besides myself in it.

I am not fond of pain, but I have had my compensations in experiences of the above-described sort and in observation and reflection upon them. I have had my exhibitions when I have not used opiates, or rather they have had me. It would make no difference in the ultimate physical and psychic analysis however if opiates were used. They explain nothing. The question still is, what are the laws of such visions or why their lawlessness?

NOTE. — Since the above was written I have had another experience with pseudopia. I lay in bed a few days from a cold and congestion about the head. One evening the visions came on and I described them aloud to my wife for half an hour. This experience was mainly of a geological sort. Rock views passed before me such as one would get in riding over the mountains in Wyoming on the Union Pacific Railroad. The rocks were at close range so that I could see all the bands of stratification in the sedimentary rocks. Sometimes the rocks were divided perpendicularly as well as horizontally so as to suggest a wall laid up artificially. But I saw no tools and no workmen. In fact I did not see a single human being in the whole half hour show. The primitive rocks appeared in all their amorphous condition. I could not get vista or prospect among or over them though I tried with all my might. But view after view of rocks in endless succession came on and went off. The only modification of bare rock (no tree or shrub or grass was in sight) was once when the view slid off to a river — drift bank in which were tumbled large boulders as is usual. One boulder was broken across the face and plainly showed the mixed gray, pepper and salt mottling of granite. This did not long continue and then the vision went back to the lithological

vision which was on before. Nothing was repeated. The variety was only equalled by the actuality as you climb the Rocky Mountains and go over the crest in Wyoming. All of a sudden the rock exhibition failed and there came out a beautiful landscape in which nothing of vegetation was wanting to completeness in effect. From embowering trees I looked down a long vista over a grain field filled with bunches of grain as farmers put them up before stacking. The field was apparently of acres in extent and the further edge faded out down a declivity with an intimation of a broad valley lower down beyond. This closed the show and I have seen nothing since and do not expect to till I have another season of congestion about the eyes.

I do not care about drawing conclusions; but I do not see why I might not have the visions of frenzied oracles, bacchants, hermits, devotees — any of the sights of sinners or saints, if my mind was bent in their particular directions.